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Electric Traction Department

Power Director Operating Guidelines

Boston Office

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ELECTRIC TRACTION POWER DIRECTORS OVERVIEW

The Power Director manages the power distribution on the Northeast Corridor between New Rochelle, NY and Washington, DC; Philadelphia to Harrisburg, PA as well as New Haven, CT to Boston, MA. They supervise the operations and sectionalizing of the Electric Traction power distribution, signal power and 3rd rail systems within their assigned territory. They perform a critical role in the Electric Traction Department for Amtrak.

There are currently three Amtrak Power Director Offices. They are located in Wilmington, DE; New York, NY; and Boston, MA. The three Power Director Offices oversee approximately 1,532 miles of catenary, 951 miles of transmission lines, 47 step-down substations, 9 switching stations and 20 paralleling stations. There are also connecting substations such as Septa's Sub 30TH Street, Sub 07 Allen Lane, Sub 01 Morton, Sub 02 Lenni and New Jersey Transit's (NJT) Morrisville Yard and Sub 48 South Amboy.

The Power Director Offices are 24-hour 7 days a week operation. The Wilmington Office is staffed by four Power Directors per shift, who are responsible for approximately 252 miles of electrified territory. The New York Office is staffed by two Power Directors per shift, who are responsible for approximately 95 miles of electrified territory. The Boston Office is also staffed by two Power Directors who are responsible for approximately 156 miles of electrified territory.

A typical 8-hour workday in the Wilmington, New York and Boston Power Director Offices would begin with a Shift Turnover. A Shift Turnover is a transfer of responsibility and information regarding the status of the system from the outgoing to incoming Power Director.

Information on the Shift Turnover would include any event in progress, outstanding clearances, DC power or work permits, equipment removed from or returned to service, changes in system configuration, scheduled work for the next tour of duty, personnel on property, signal power system set-up and any unusual conditions including impending inclement weather.

A Shift Turnover occurs when the relief for the next shift is physically present and ready to assume the duties of the Power Director. After a Shift Turnover has been completed, the Power Director on duty will:

- **Conduct** themselves in a professional manner.
- **Review** territory.
- **Utilize** proper telephone and radio communication techniques.
- **Reviews** and **maintains** the Logbook, Clearance and DC Power Permit forms, Shift Turnover report, Outage Scheduler, Track Usage sheet and the Out of Service Equipment Log from the date last worked.
- **Acknowledge** and determine validity of any alarms received.
- Continuously **monitor** the system to determine unusual conditions and report that information to the Load Dispatcher.

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- **Monitor** radio transmissions.
- **Issue** clearances, DC power and work permits for the protection of Amtrak employees and other personnel.
- **Handle** request for planned outages.
- **Coordinate** Electric Traction functions and outages within, and other departments as required such as the Load Dispatcher, other Power Directors, Utility Companies, Trouble Desk, and Train Dispatchers.
- Directly **supervise** and (in coordination with the Load Dispatcher when required) the safety of operation, resources, and the configuration and switching of the transmission, substation, trolley, signal and third rail electrification system components.
- **Respond** appropriately to abnormal system conditions and problems, to minimize the impact to the electrification system and train operations.
- **Coordinate** with Electric Traction management, supervision, and field personnel in response to system outages. During off-hours, proper callouts must be initiated to affect the response.
- **Identify**, **report**, and **document** all unusual events.
- **Disseminate** information throughout the system as required. (Personnel whose area of responsibility is directly affected by an outage or incident).
- **Follow** up on all incidents in a timely fashion.
- **Prepare** proper Shift Turnover for the incoming Power Director.

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SECTION 1
CORPORATE STRUCTURE

1.1 AMTRAK'S NETWORK

Amtrak, created in 1971, is the nation's passenger rail corporation serving 46 states, the District of Columbia and three Canadian provinces. Amtrak operates more than 300 trains each day — at speeds up to 150 mph — to more than 500 destinations over approximately 21,00 route miles. Amtrak owns about 730 route miles of track primarily in the portion of the United States Northeast shown in Figure 1-1. The remainder of Amtrak's routes operate over privately owned and maintained tracks.

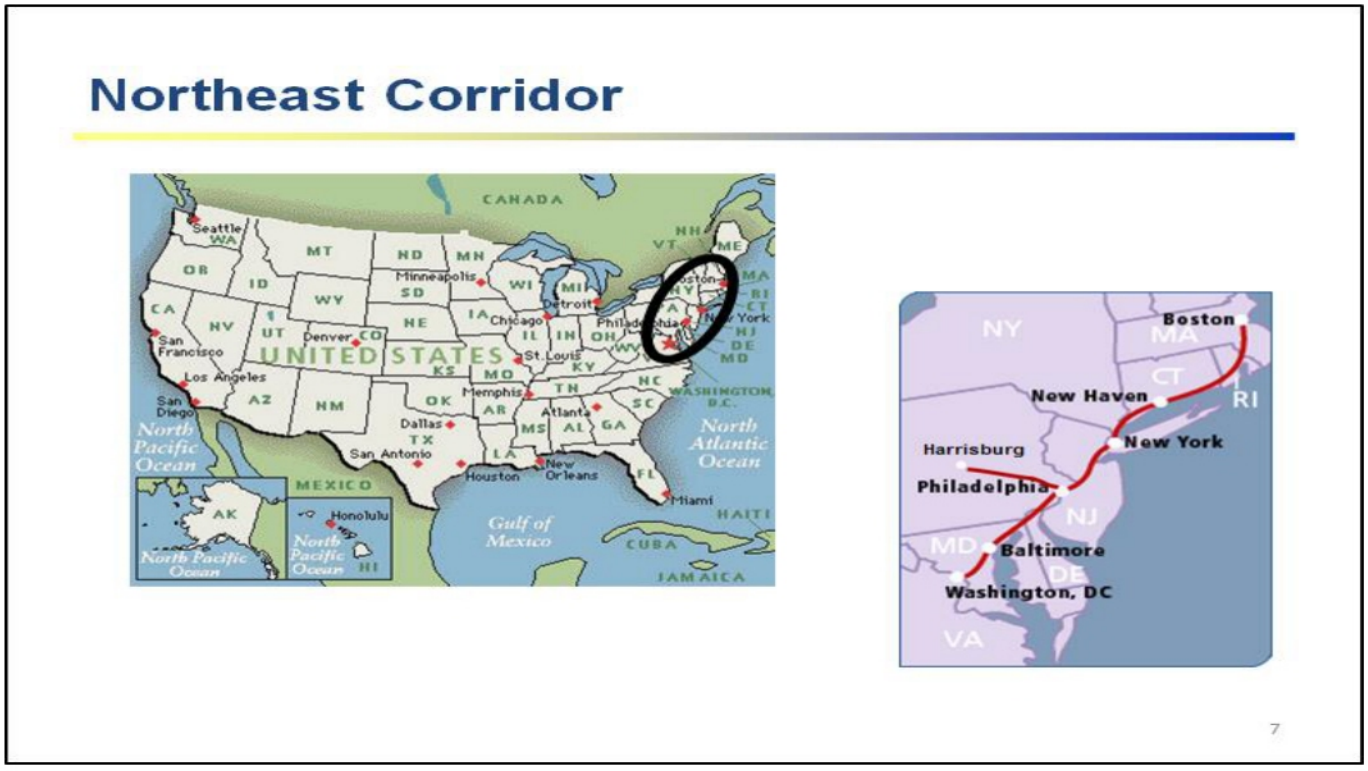

Figure 1-1. Northeast Corridor

Amtrak is a vital part of an interconnected national transportation network, providing important transportation, environmental, and economic benefits. There are many reasons why Amtrak provides an essential piece of this national transportation system. When Amtrak was established by Congress in 1971, the mandate of the National Railroad Passenger Corporation was to provide modern, cost-efficient, and energy-efficient intercity rail passenger transportation between crowded urban areas and in other areas of the United States. Rail passenger transportation helps alleviate overcrowding of airways and highways, contributes to a harmonious interconnected transportation system, creates jobs, stimulates private economic activity, and contributes significant environmental benefits to the nation.

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1.2 HISTORICAL DEVELOPMENT

- The Main Line of Public Works was a railroad and canal system across southern Pennsylvania between Philadelphia and Pittsburgh. Built between 1826 and 1834 by the Commonwealth of Pennsylvania, it included the Philadelphia and Columbia Railroad.
- Philadelphia and Columbia Railroad stretched 82 miles from Philadelphia to Columbia near the former ferry site known as Wright's Ferry, in Lancaster County.
- The Commonwealth of Pennsylvania granted a charter to the Pennsylvania Railroad (PRR) in 1846 to build a private rail line that would connect Harrisburg to Pittsburgh.
- The PRR was granted track rights over the Philadelphia and Columbia Railroad and gained control of the three short lines connecting Lancaster and Harrisburg, instituting an all-rail link between Philadelphia and Pittsburgh by 1854.
- In 1857, the PRR purchased the Main Line of Public Works from the state of Pennsylvania and abandoned most of its canals and inclined planes. Over the next 50 years, PRR would expand by gaining control of other railroads by stock purchases and 999-year leases. This line is still an important cross-state corridor, carrying Amtrak's Philadelphia to Harrisburg Main Line.
- In 1871, the PRR leased the United New Jersey Railroad and Canal Company, which included the original Camden and Amboy Railroad from Camden to South Amboy, NJ, as well as a newer line from Philadelphia to Jersey City, NJ, much closer to New York, via Trenton, NJ. Track connections in Philadelphia were made via the PRR's Connecting Railway and the jointly owned Junction Railroad (Philadelphia).
- On July 2, 1872 the PRR's Baltimore and Potomac Railroad opened between Baltimore and Washington, D.C. This route required transfer via horse car in Baltimore to the other lines heading north from the city. On June 29, 1873, the Baltimore and Potomac Tunnel through Baltimore was completed.
- On July 24, 1873 the Union Railroad (Baltimore) line opened extending the line eastward through another tunnel to the PRR's other Baltimore line, the Philadelphia, Wilmington & Baltimore Railroad (PW&B) northeast to Delaware and Pennsylvania. This route eliminated the transfer in Baltimore. PRR officials contracted with both the Union Railroad and the Philadelphia, Wilmington, and Baltimore Railroad (PW&B) Railroad for access to this line. The PRR's New York–Washington trains began using the route the next day. This line is still in use today, carrying Amtrak's New York to Washington Main Line.
- The North River and East River Tunnels are a pair of tunnels built between 1904 and 1908 by the Pennsylvania Railroad (PRR) to allow its trains to reach Manhattan and cross the East River to Long Island City in Queens. The Hudson River was previously crossed by transfer to ferries across the river. They opened for passenger service in late 1910. Sunnyside Yard also was completed in 1910. This was the final piece of the New York to Washington Main Line into what is now Pennsylvania Station in Manhattan, New York City.
- The Hellgate Bridge construction began on March 1, 1912 and ended on September 30, 1916. Built to link New York and the Pennsylvania Railroad (PRR) with New England and the New Haven Railroad (NH). The bridge was dedicated and opened to Rail traffic on March 9, 1917, with Washington–Boston through train’s first running on April 1, 1917.

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- In 1968 the Penn Central Transportation Company was created through a merger between PRR and New York Central Railroads. Penn Central was required to absorb the New York, New Haven and Hartford Railroad in 1969 as a condition of the merger. The Penn Central bankruptcy in the early 1970s coincided with the creation of Amtrak.
- In 1976 a substantial portion of the former New Haven main line between New York and Boston was transferred to Amtrak and now forms a major portion of the electrified Northeast Corridor between New Haven and Boston. Metro North Railroad acquired the portion between New Rochelle and New Haven.

Pennsylvania Railroad

The Pennsylvania Railroad was founded in 1846. The PRR (referred to as “Pennsy”) was headquartered in Philadelphia, PA. Over the years, it acquired, merged with, or owned part of at least 800 other rail lines and companies. At the end of 1925, it operated 10,515 miles of rail line.

The first overhead electrification was the Philadelphia terminal area, where PRR officials decided to use overhead lines to supply power to the suburban trains running out of Broad Street Station. Unlike the New York terminal system, a direct current (DC) 650-volt third rail to power PRR locomotives, overhead wires would carry 11,000V 25 Hz alternating current (AC) power: the system used for all future installations.

In 1915, electrification of the line from Philadelphia to Paoli, PA was completed. Other Philadelphia lines electrified were the Chestnut Hill Branch (1918), White Marsh (1924), West Chester, the main line to Wilmington, DE (1928) and in 1930 the Schuylkill Branch to Norristown, PA along with the rest of the main line to Trenton, NJ.

In January 1933, through main-line service between New York and Philadelphia/Wilmington and Paoli was placed in operation. The first test run of an electric train between Philadelphia and Washington occurred on January 28, 1935.

On February 1, the Congressional Limited in both directions were the first trains in regular electric operation between New York and Washington, drawn by the first of the GG1-type locomotives. All regular passenger trains between these cities were electrified by March 15.

To complete the electrification project initiated in 1928, work was started January 27, 1937, on the main line from Paoli to Harrisburg, PA.

January 15, 1938 the first passenger train, the Metropolitan, went into operation over the newly electrified line from Philadelphia to Harrisburg, PA. On February 1, 1968 the PRR merged with the New York Central. Figure 1-2 shows a PRR engine passing by Sub 35 Princeton.

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Figure 1-2. PRR Engine Passing Sub 35 Princeton

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Penn Central Railroad

Penn Central Railroad was created in 1968, It was a merger between the Pennsylvania (PRR) and the New York Central Railroads. The Penn Central Railroad declared bankruptcy on June 21, 1970 but continued to operate freight under bankruptcy court protection. As a result, Congress created the Consolidated Rail Corp (Conrail) on April 1, 1976. Figure 1-3 shows Penn Central Railroad engines sitting in Penn Coach Yard- Philadelphia.

Figure 1-3. Penn Central Railroad Engines Sitting in Penn Coach Yard- Philadelphia

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Amtrak

Congress created the Rail Passenger Service Act in 1970. Operations began on May 1, 1971. Amtrak took ownership of the Northeast Corridor (NEC) in 1976. More than 260 million passenger trips are made on the NEC per year, of which 17.1 million annual trips are made by Amtrak passengers. The balance is made on services provided by Amtrak's eight commuter railroad partners that share the NEC. The eight commuter services that operate on the NEC are Massachusetts Bay Transportation Authority, Shore Line East, Metro-North, Long Island Railroad, New Jersey Transit, Southeastern Pennsylvania Transportation Authority, MARC and Virginia Railway Express. Approximately 750,000 trips are made on the NEC - either on Amtrak or one of the commuter railroads daily. More than 2,100 passenger trains and 60 freight trains operate on some portion of the NEC every day. Figure 1-4 shows an Amtrak ACS-64 train set.

Figure 1-4. Amtrak ACS-64 Train Set

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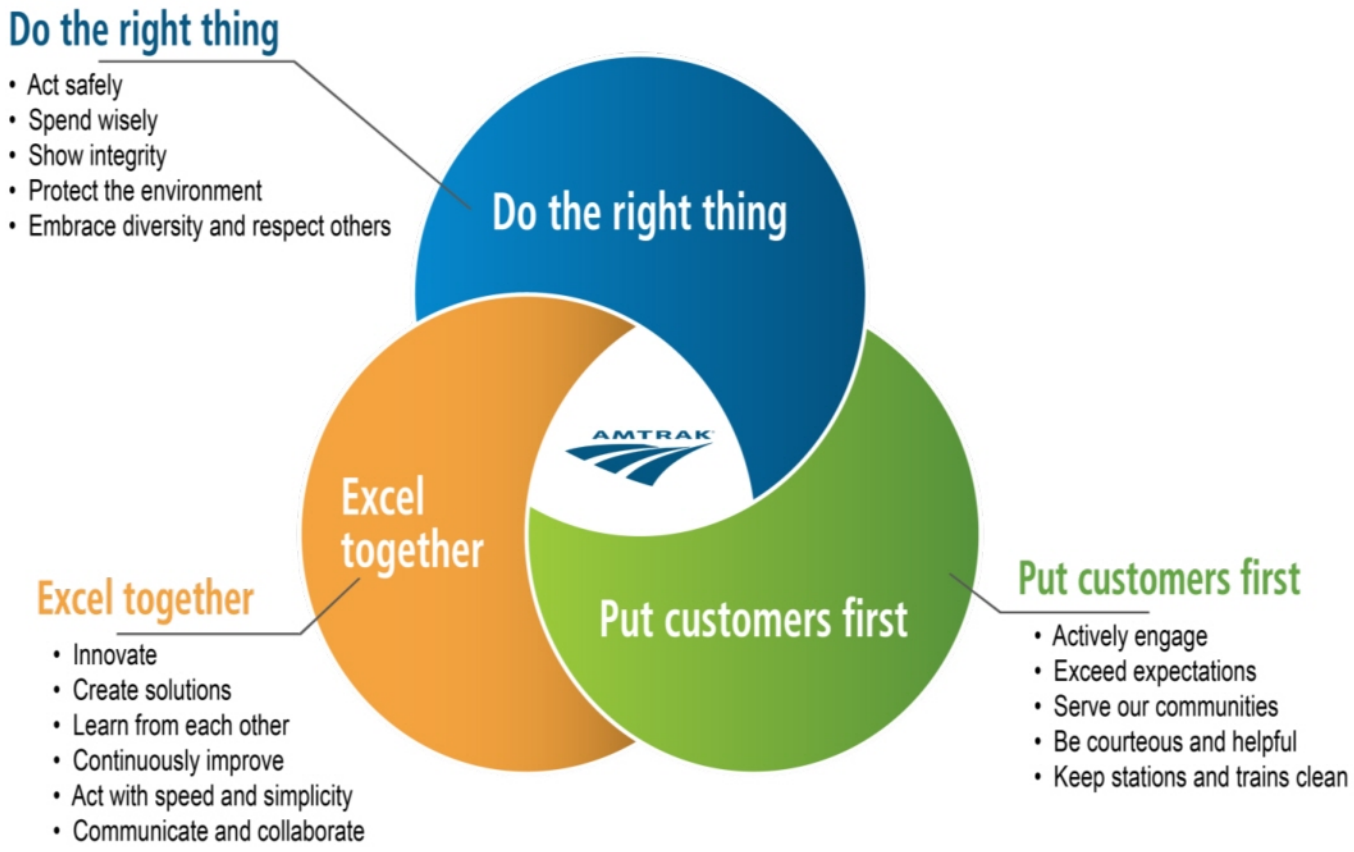
1.3 AMTRAK MISSION

Today Amtrak is a public corporation with corporate headquarters in Washington, DC. The company's mission statement gives everyone in the organization a central focus. The mission statement states that:

Amtrak is America's passenger railroad whose mission is "delivering intercity transportation with superior safety, customer service, and financial excellence."

Collectively and individually, it is the job of everyone with a connection to Amtrak to give our customers a travel experience that exceeds their expectations, while ensuring we have a safe operation and that we are continually building the financial strength of the company. In its more than 46 years of existence, Amtrak has revived rail passenger service in the United States and made it a critical component of a balanced national transportation system.

1.4 AMTRAK CORE VALUES



Do the Right Thing. This value must be central to everything we do. It starts with always being safe – for ourselves, our co-workers, and our customers. On a personal level, it means that we always act with integrity. Our stakeholders should know us as honest, trustworthy, and reliable – and we must spend Amtrak's money with the same care we use for our own. In dealing with other people, we are always respectful – and we recognize that we create the best ideas when we include people of different cultures, backgrounds and viewpoints in our work. Finally, we do everything we can to protect our

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environment. We owe it to future generations to reduce waste and reduce our carbon footprint. A lot of **"Do the Right Thing"** comes down to the Golden Rule – namely, that we must treat others as we would like to be treated.

Put Customers First. This value speaks to why we exist. Prudently taking good care of our customers is the essence of our mandate from Congress – and it is how we ensure our continued livelihoods with this company. Our team has a strong sense of service today. Our challenge is that we must continually act upon it. To "**Put Customers First,**" all of us must be actively engaged in the needs of our customers, all the time. This means we don't wait for a customer to ask for help. If we see someone struggling with baggage or looking uncertain on where to find their gate, we provide whatever assistance they need. We are always courteous and helpful, and we keep our stations and trains clean. In short, every time we interact with a customer, we must exceed their expectations.

Excel Together. This value speaks to teamwork and performance. Many elements go into building a strong and high-performing team. It starts with communication. We must work toward the same goals together – and we need to be talking with each other all the time about what's important, what needs to be done now, and how we can improve. We must also seek to learn from each other. Each of us has a set of unique strengths and expertise that we need to maximize for Amtrak to achieve its goals. And we should always look to improve – ideally by being innovative. Our customers demand modern solutions, and today's business environment requires speed and simplicity. In doing all these things, we will **"Excel Together"** – and there will be no limits to what we can accomplish.

1.5 AMTRAK SAFETY PROGRAM

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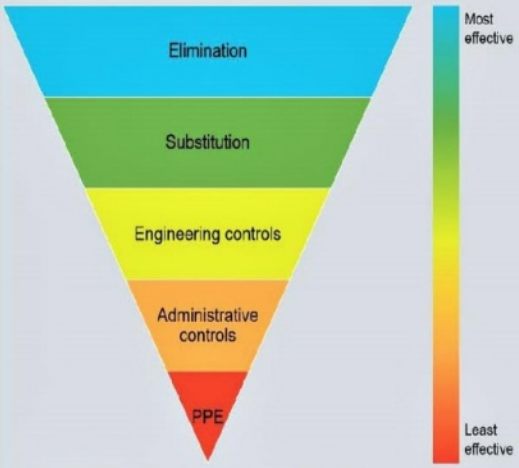
Just Culture principles

Human error	At-risk behavior	Reckless behavior
Inadvertent actions: slip, lapse, mistake	A choice: risk not recognized or believed justified	Conscious disregard of a substantial and unjustifiable risk
Manage through changes in: ▪ Process ▪ Procedures ▪ Training ▪ Design ▪ Environment ▪ Behavioral choices	Manage through: ▪ Removing incentives for at-risk behavior ▪ Creating incentives for healthy behaviors ▪ Increasing situational awareness	Manage through: ▪ Remedial action ▪ Disciplinary action

Hierarchy of controls



Elimination: Physically remove the risk

Substitution: Avoid the hazard posing a risk

Engineering controls: Materially improve conditions

Administrative controls: Briefings, bulletins, testing, etc.

Personal Protective Equipment (PPE): Protecting against risk exposure

Safety Management System

- Know our policies
- Understand the changes
- Apply as intended
- Shape our culture

- Celebrate the wins
- Communicate
- Reinforce training
- Participate in activities

- Adopt the mindset
- Proactively mitigate risk
- Account for change
- Report

- Verify if it's working
- Coach and provide feedback
- Investigate root cause
- Continuously improve

The results pyramid

The **results** we achieve are directly impacted by the **actions** we take; the actions we take are influenced by the **beliefs** we hold; and the beliefs we hold are created by the **experiences** we share.

Partners In Leadership ®

Steps to accountability

ABOVE THE LINE®
Steps To Accountability®

THE LINE

BELOW THE LINE®
Blame Game

Partners In Leadership ®

SBI model

Situation	• Describe the *situation* where you observed the behavior (provide specifics on when and where)
Behavior	• Describe the actual *behavior* you observed (provide specifics of what you saw)
Impact	• Describe the *impact* of the behavior on you, others, and Amtrak

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1.6 CORPORATE STRUCTURE

Amtrak is a large organization with over 24,000 employees. The Power Directors are in Amtrak's Electric Traction Department. The Power Directors interact with personnel in the Electric Traction Department throughout the Northeast Corridor.

Administrative, operation and payroll matters are currently handled through the Electric Traction Department's System Operations Office. Figure 1-5 shows where the Power Directors fall in Amtrak's Corporate structure.

1.7 ELECTRIC TRACTION'S MISSION

The function of the Electric Traction Department is to:

- Provide electric traction power for trains in a safe, economical, and reliable manner.
- Ensure integrity of the entire electrified territory.
- Initiate, maintain, and enforce standards for equipment maintenance and construction designs.

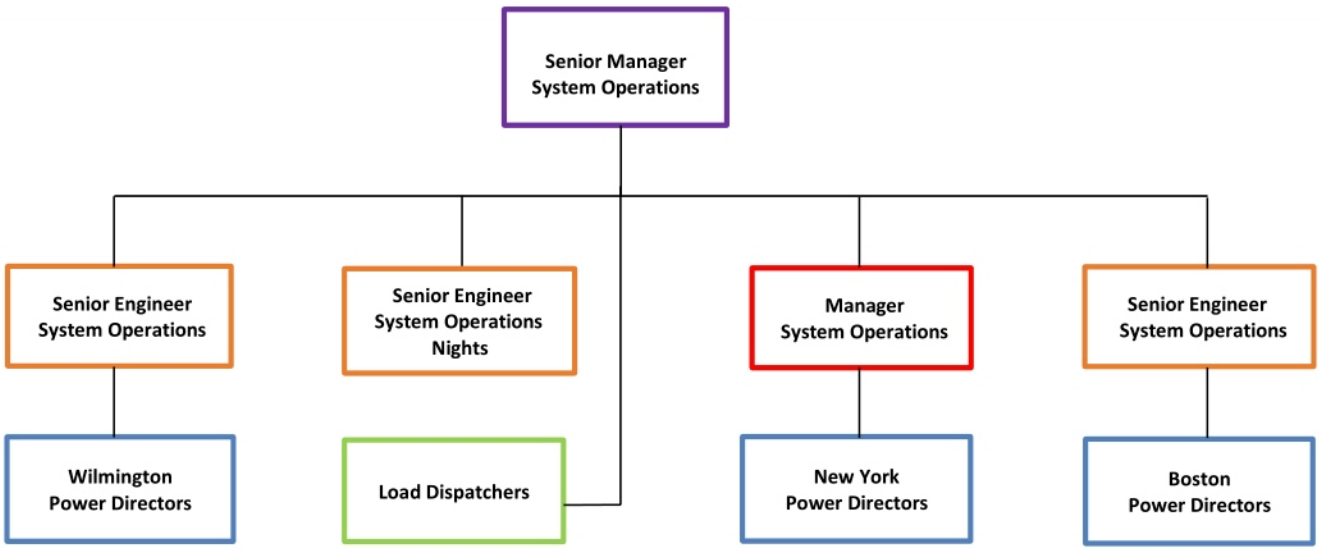

Figure 1-5. Electric Traction System Operations Organization Chart

1.8 INTERACTION WITH TRAIN DISPATCHERS

A Train Dispatcher is responsible for the movement of trains within an assigned territory. To move trains safely in all directions, Train Dispatchers need to know the following:

- The location of each train in the territory for which they are responsible.
- The tracks that are de-energized so that they do not permit an electric train into that section of the overhead catenary system.
- Track that may have foul time so as not to permit a train (electric or non-electric) into a section of track where personnel might be working.

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Since electric trains run on the Electric Traction power system controlled by the Power Director, the Power Director will need to communicate all activities on the electrification system that will affect electric train movement to the Train Dispatcher. The primary activity under the control of the Power Director that will affect the movement of electric trains are the de-energization of a section of the overhead catenary or third rail protected by a plate order.

Under normal operating conditions, the Power Director needs to request and receive permission for a plate order from a Train Dispatcher-prior to removing power from the overhead catenary-or third rail. The Train Dispatcher knows the location of the trains, routes and schedules, therefore, knows when it is possible to de-energize a section of catenary and provide blocking from routing a train into a de-energized section of catenary or third rail.

The Power Director may issue an emergency plate order without the permission of a Train Dispatcher but must inform the Train Dispatcher immediately upon doing so. A potential emergency condition must exist before a Power Director takes such action. An emergency condition could be described as one where immediate de-energization of the overhead catenary is required when life or safety of equipment is compromised, or train movement could be impeded.

1.9 INTERACTION WITH LOAD DISPATCHERS

The Load Dispatcher monitors and regulates power demands for the 25 Hz electrification system. The Load Dispatcher position in Philadelphia manages the generation and 25 Hz (138 kV) transmission network as well as oversees the Hellgate section of Amtrak's electrified territory in New York. Managing these systems makes the Load Dispatcher responsible for:

- Maintaining continuity and availability of power for operation of trains.
- Interacting with utilities to monitor and control voltage levels and power levels.
- Issuing permits and switching orders to Power Directors for apparatus affecting Amtrak's 25 Hz (138 kV) transmission network and the Hellgate section.
- Directly supervise the safety of operation, resources, as well as the configuration and switching of the 25 Hz electrification system components.

Historically, the railroad has divided control of the Electric Traction system into two areas. Generation and (138 kV) transmission are the responsibility of the Load Dispatcher while distribution and substations are the responsibility of the Power Director. Power Directors have the actual supervisory control of substations. Power Directors operate apparatus, which affect Amtrak's 25 Hz (138 kV) transmission network, under the direction of the Load Dispatcher. All other apparatus which do not affect the transmission network is done under the direction of the Power Director.

Load Dispatchers supervise manned frequency converter locations to switch and to alter generator parameters. There is currently one Load Dispatcher Office. The office is located in Philadelphia, PA on the 4th floor of the Northeast corner of Amtrak's 30th Street Station.

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Additionally, the Load Dispatcher is responsible for ensuring that the power needed to meet Amtrak's daily electrical train load is available. They achieve this goal by scheduling power resources from various electrical utilities and to a smaller extent by scheduling generation from Amtrak's converter stations. The Load Dispatcher ensures that the scheduled power supply is safely delivered to Amtrak's (138 kV) transmission network.

The Power Directors coordinate with the Load Dispatcher, ensuring that the trains run with power supplied to the overhead catenary system. The Power Director notifies the Load Dispatcher of all failures or incidents that affect the electrification system operation.

1.10 DIVISIONS WITHIN THE ELECTRIC TRACTION DEPARTMENT

Electric Traction Department personnel are spread throughout the entire Northeast Corridor territory. The department consists of managers who are responsible for overseeing the design, ongoing construction and maintenance of the entire electrified territory. Specifically, managers have responsibility for:

- Operations and maintenance.
- 138 kV transmission system.
- The overhead catenary system.
- Amtrak substations.
- Amtrak converter stations.
- Signal power system.
- Third rail system.
- The SCADA system to monitor and control the electrified territory.

Division managers responsible for maintenance and construction each have control over specific regions within the Northeast Corridor, namely the:

- New England Division- East which is headquartered in Boston, MA
- New England Division- West which is headquartered in Groton, CT
- New York Division- East which is headquartered in New York, NY
- New York Division- West which is headquartered in Trenton, NJ
- Mid-Atlantic Division- North which is headquartered in Philadelphia, PA
- Mid-Atlantic Division- South which is headquartered at Quad Ave. in Baltimore, MD

The various Assistant Division Engineers, with the responsibilities described above, each have their own staff to ensure that inspections and maintenance of the equipment are up to date as well as various project goals are met. It should be noted that the splits for each division are as follows: The Mid-Atlantic Division is MP 29.3, north of Ragan, the New York Division is MP 3.2, east of Bergen, and the New England Division is W83 Richmond Switching Station MP 150.10.

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SECTION 2
POWER DIRECTOR OFFICES

A Power Director operating zone is a geographical section of the Amtrak electrified system whose switching, and monitoring operations are conducted under the direction of the Power Director. Amtrak's Northeast Corridor is divided up into eight operating zones. The eight operating zones are controlled by Power Directors in offices in Boston, MA; New York, NY and Wilmington, DE. The zones are numerically identified from 1 through 10 and it should be noted that there is no Zone 7 or 9.

There are currently three (3) Power Director Offices:

1. Boston, MA
2. New York, NY
3. Wilmington, DE

2.1 BOSTON POWER DIRECTOR OFFICE

The Boston Power Director Office, as shown in Figure 2-1, monitors and controls Zone 10. There are two Power Directors on shift at any given time in the Boston Office. The geographical control area of Zone 10 is split into two geographical territories. Zone 10 East extends from South Station in Boston, MA MP 228.9 to W83 Richmond Switching Station MP 150.10. Zone 10 West extends from W83 Richmond Switching Station MP 150.10 to the Division Post MP 72.9 in New Haven, CT.

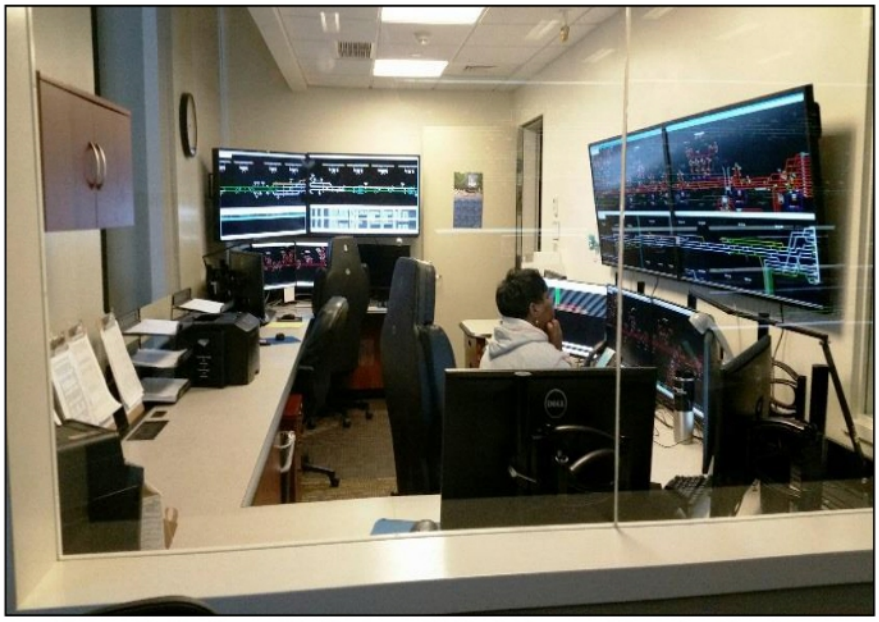

Figure 2-1. Zone 10 East and West Power Director Desks

Zone 10 is unique from the other Power Director zones in that it is a single phase, 60 Hz 2×25 kV constant tension overhead catenary system consisting of four traction power substations, three switching stations, and eighteen paralleling stations strategically located between New Haven, CT and Boston, MA.

The Boston Power Director Office is located in downtown Boston inside South Station. This office contains a SCADA operated control board that displays the condition of high voltage circuits and components relating to Amtrak's 1ϕ, 25 kV, 60 Hz traction power system between New Haven, CT and Boston, MA. This allows the Power Directors information to make adjustments based on constantly changing conditions. The functionality of this office is critical to the continued operation of Amtrak trains. The Load Dispatcher does not issue any permits on any of the equipment or circuits to the Zone 10 Power Director.

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2.2 NEW YORK POWER DIRECTOR OFFICE

The New York Power Director Office monitors and controls Zones 1, 2 and 3. There are usually two Power Directors on shift at any given time in the New York Office. One Power Director has responsibility for Zone 1, another has responsibility for Zones 2 and 3. Occasionally the zones can be split due to excessive workload or when inclement weather is predicted.

The Zone 1 Power Director geographic limits extend from MP 18.7, west of CP 216 to MP 3.2, east of Bergen. Figure 2-2 shows the Zone 1 Power Director desk.

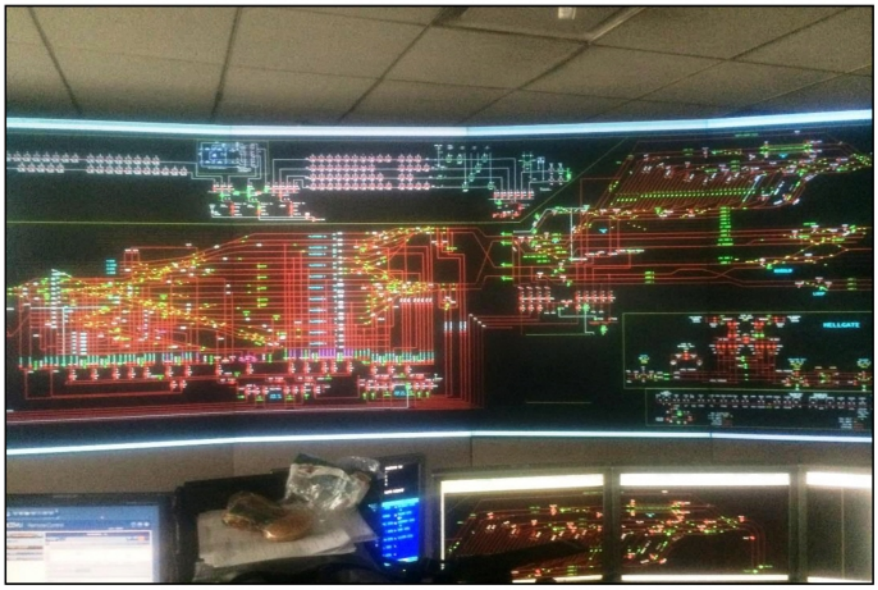

Figure 2-2. Zone 1 Power Director Desk

Zone 1 is unique from the other Power Director zones in that it is the only zone that is responsible for Amtrak's DC Third Rail system.

The Zone 2/3 Power Director geographic limits extend from MP 3.2, east of Bergen to MP 76, east of Holmes. Figure 2-3 shows the Zone 2/3 Power Director desks. There is only one Power Director that controls both zones at a given time.

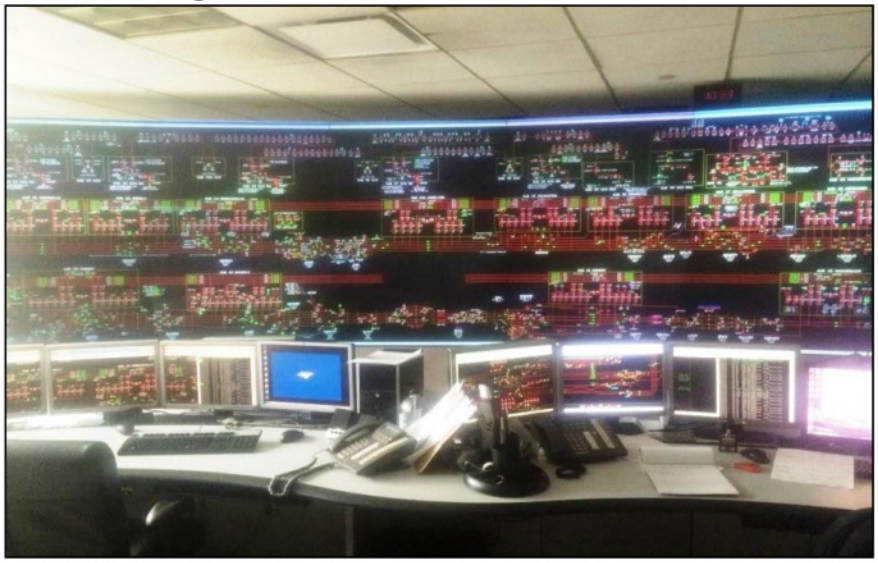

Figure 2-3. Zones 2 and 3 Power Director Desks

The New York Power Director Office is located in Midtown Manhattan, NY in the Claytor-Scannell Control Center building. This office contains a SCADA operated control board that displays the condition of high voltage circuits and components relating to Amtrak's 25 Hz & Hellgate traction power and signal systems as well as Amtrak's DC third rail. This allows the Power Directors information to make adjustments based on constantly changing conditions. The functionality of this office is critical to the continued operation of Amtrak trains.

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2.3 WILMINGTON POWER DIRECTOR OFFICE

The Wilmington Power Director Office monitors and controls Zones 4, 5, 6 and 8. There are four Power Directors on shift at any given time in the Wilmington Office.

The Zone 4 Power Director geographic limits extend from MP 76, east of Holmes to Glenolden MP 8.1 and MP 21.3, west of Paoli.

Zone 8 geographic limits extend from MP 21.3, west of Paoli to Harrisburg MP 104. Figure 2-4 shows the Zone 4 and Zone 8 Power Director desks.

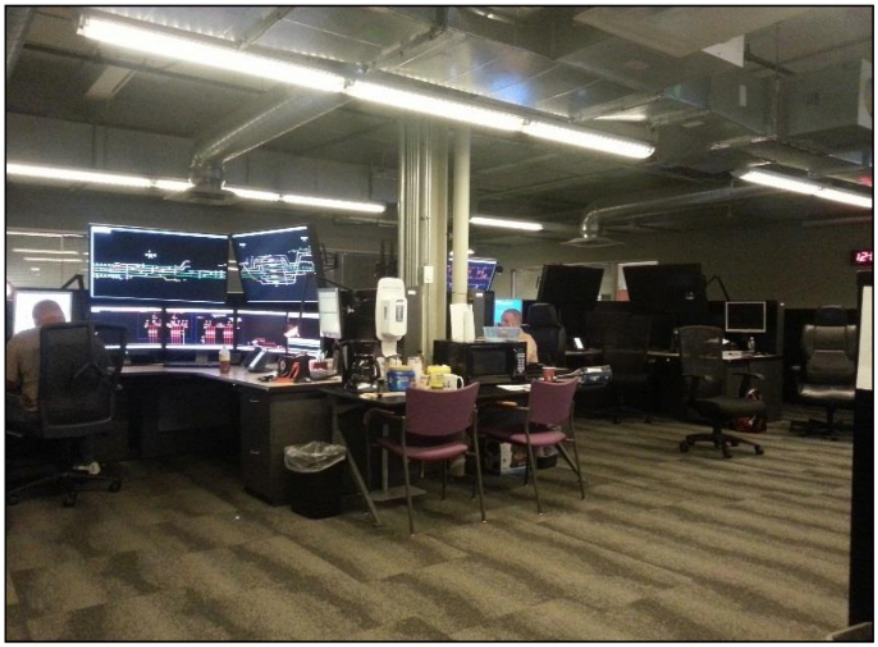

Figure 2-4. Zone 4 and 8 Power Director Desks

The Zone 5 Power Director geographic limits extend from Glenolden MP 8.1 to Gunpow MP 79.5.

Zone 6 geographic limits extend from Gunpow MP 79.5 to Washington MP 136. Figure 2-5 shows the Zone 5 and Zone 6 Power Director desks.

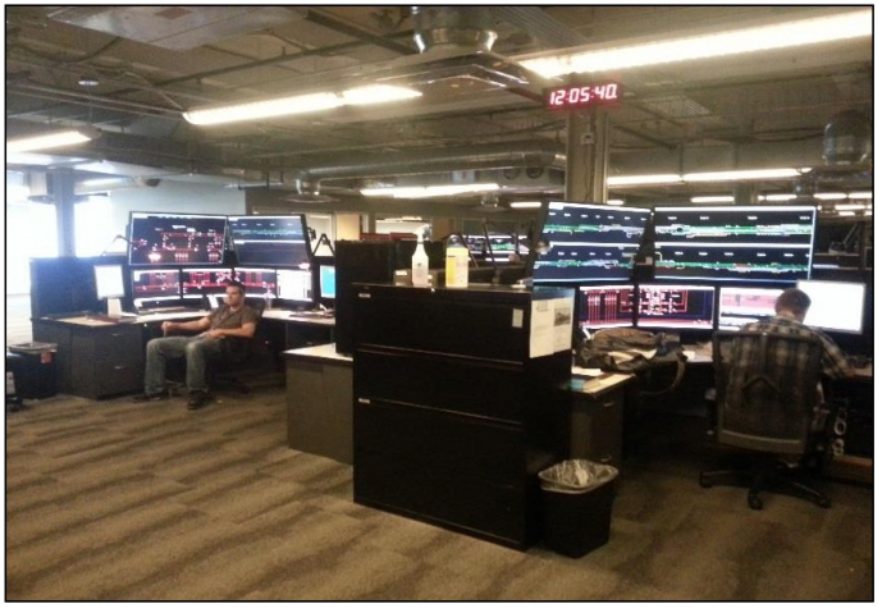

Figure 2-5. Zone 5 and 6 Power Director Desks

The Wilmington Power Director Office is located in Wilmington, DE on the first floor of the CNOC Building. This office contains a SCADA operated control board that displays the condition of high voltage circuits and components relating to Amtrak's 25 Hz traction power and signal system. This allows the Power Directors information to make adjustments based on constantly changing conditions. The functionality of this office is critical to the continued operation of Amtrak trains.

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SECTION 3
25 HZ ELECTRICIFICATION SYSTEM OVERVIEW

To better understand the entire scope and operation of the 25 Hz electrification system, it is helpful to view and study the system as being comprised of the following seven elements independently:

1. Power Generation
2. Step-Up Substations
3. Power Transmission
4. Step-Down Substations
5. Switching Stations
6. Catenary System
7. Signal Power System

3.1 POWER GENERATION

The Amtrak electrification system is a 25 Hz, single-phase type. Therefore, it is necessary to generate 25 Hz power or convert conventional 60 Hz, three-phase power, by either hydro, mechanical, or power electronics technology. Frequency converters, mostly synchronous-motor, synchronous generator sets but more recently static types, take commercial 3ϕ, 60 Hz and convert it to 1ϕ, 25 Hz power.

Amtrak currently employs three methods of power conversion or generation, at six strategic locations throughout the interconnected system. They are rotating frequency converters (RFC), hydro-electric generators (water wheels), and static frequency converters (SFC) of the Cyclo and DC link type design. The output of power to the transmission system is measured in megawatts (1 million watts).

Amtrak's six 25 Hz converter stations are located at Jericho Park in Bowie, MD; Lamokin in Chester, PA; Safe Harbor in Conestoga, PA; Richmond in Philadelphia, PA; Metuchen in Metuchen, NJ and Sunnyside in Queens, NY. The frequency converters at Lamokin are of the rotating type. Safe Harbor is a 25 Hz hydro-electric generating facility with one 25 megawatt (MW) RFC. Jericho Park, Richmond and Sunnyside are static frequency converters. Metuchen employs both a rotating unit as well as two static converters.

The Load Dispatcher is responsible for the monitoring and the regulation of the power demands for the 25 Hz electrification system between Queens, NY and Washington, DC as well as Philadelphia to Harrisburg, PA.

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Rotating Frequency Converters

Rotating frequency converters are large motor generator sets consisting of a 60 Hz, three-phase motor with a 13.8 kV input that drives a 25 Hz, single-phase generator with an output of 13.2 kV. The mechanical energy of the motor drives a shaft coupled with the generator to produce the electrical energy required for distribution to the step-up station. A generator circuit breaker connects the output source to a (13.2 kV) bus section at the step-up station. Figure 3-1 shows a Lamokin 60 Hz, three- phase motor being rehabbed.

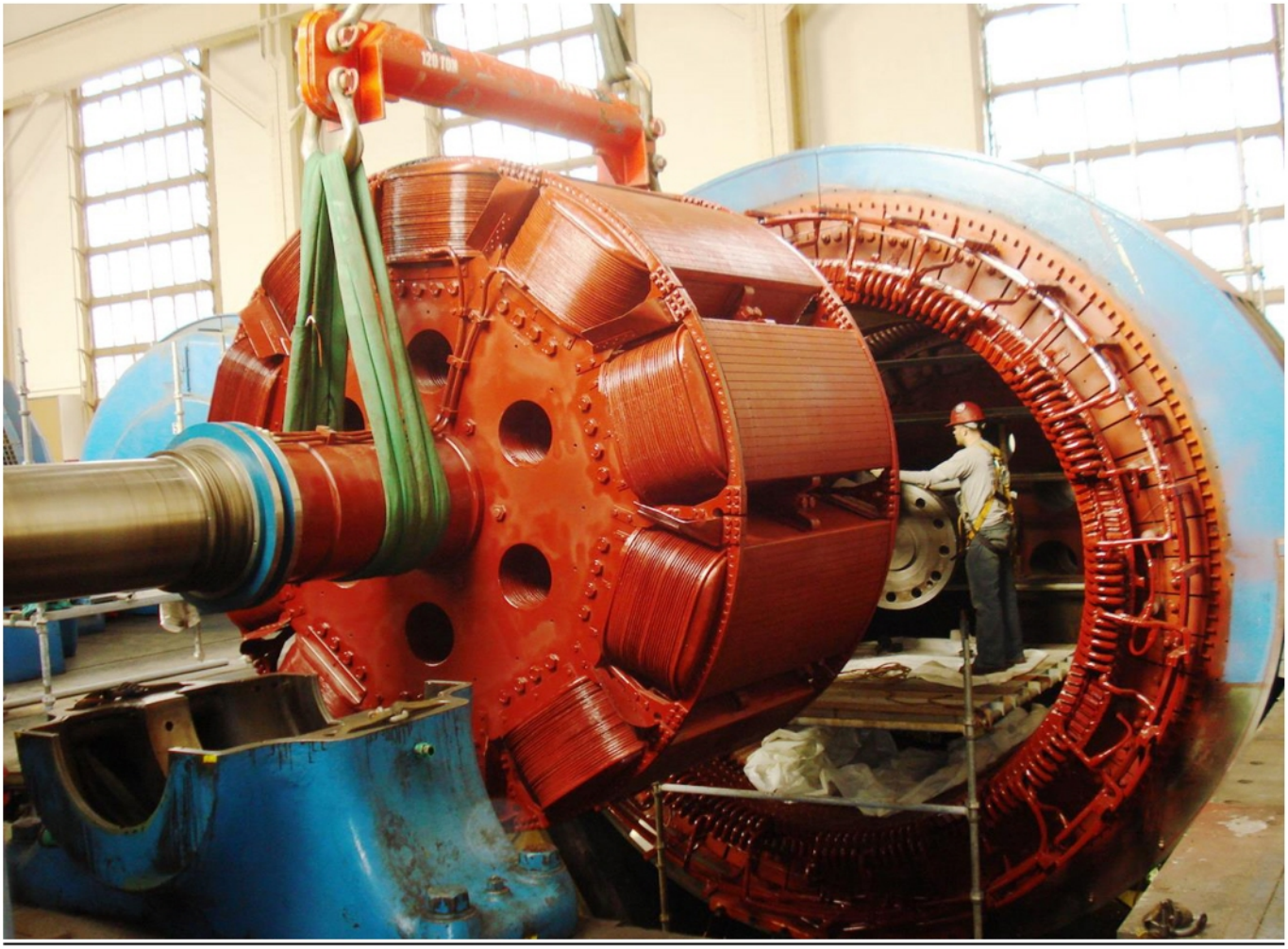

Figure 3-1. Lamokin 60 Hz, Three-Phase Motor

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Hydro-Electric Generators

Hydro-electric generators connected to the Amtrak system consist of direct water-driven Kaplan type turbine generators located at Safe Harbor's Waterpower facility in Conestoga, PA. The kinetic energy of the river flow is utilized to drive the generators, thus providing the mechanical energy required to create an electrical energy output from the generator. A generator circuit breaker connects the output source tc a (13.2 kV) bus section at the step-up station. Figure 3-2 shows Safe Harbor's water-driven Kaplan type turbine generators.

Figure 3-2. Safe Harbor's Water-Driven Kaplan Type Turbine Generators

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Static Frequency Converters

Static (solid-state) frequency converters employ power electronics technology by converting the 60 Hz, three-phase sine wave to form a 25 Hz, single-phase, output. Figure 3-3 shows a Richmond PCI module.

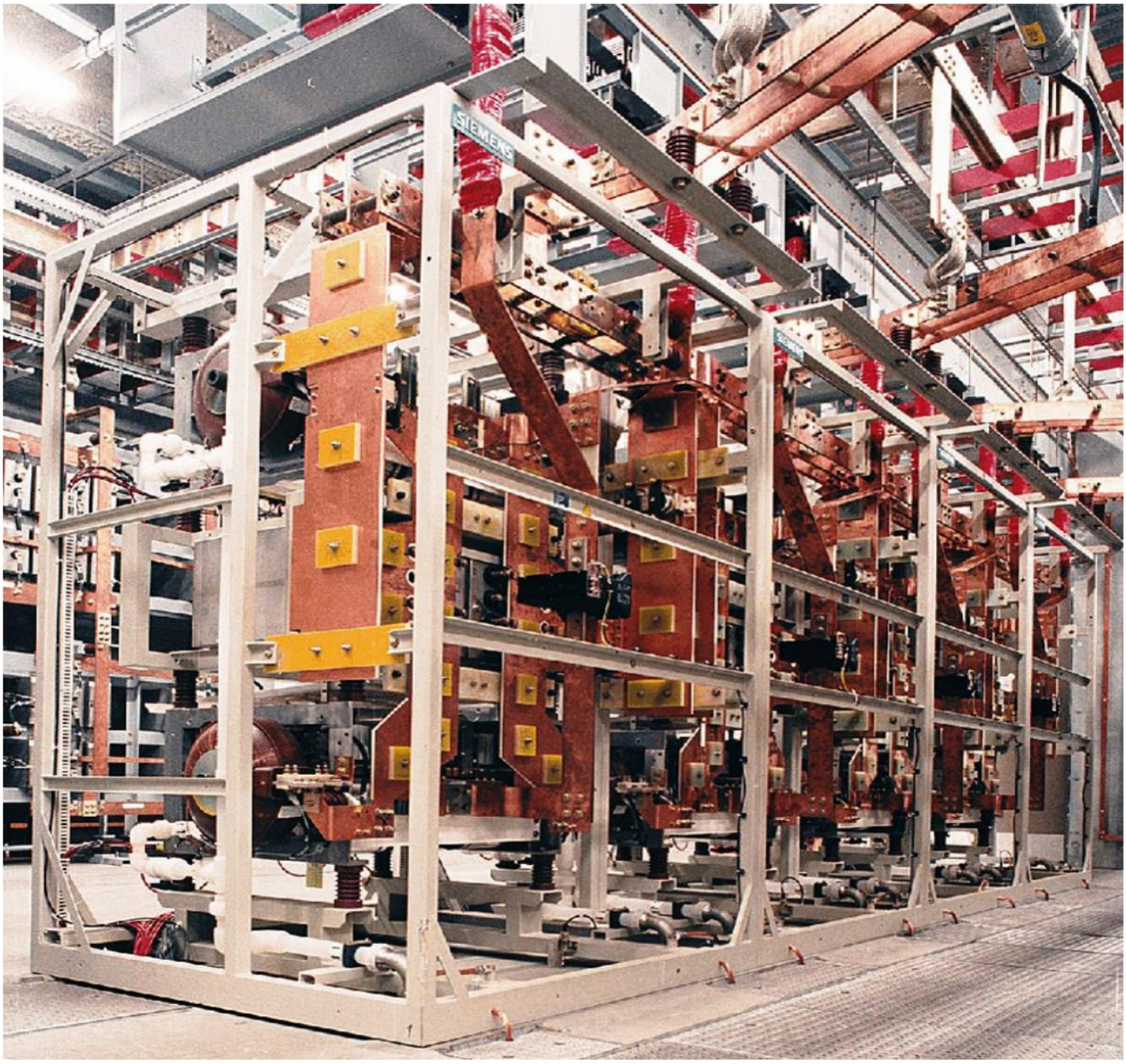

Figure 3-3. Richmond PCI Module

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Utilities

There are five utilities that supply power to six locations (along the Northeast Corridor). These utilities are:

- Philadelphia Electric Company (PECO Energy)
- Public Service Electric & Gas of New Jersey (PSE&G)
- Baltimore Gas & Electric (BG&E)
- Brookfield Renewable
- Consolidated Edison of New York (CON-ED)

The delivery point locations are listed in Table P-1 below. Amtrak owns, operates, and maintains the Sunnyside, Richmond, Jericho Park and Metuchen converter stations.

Table P-1. Power Generation Data

Location	Utility	Units	Type	Rating	Total Cap
Sunnyside	CON-ED	4	DC Link SFC	7.5 MW ea.	30 MW
Metuchen	PECO/ PSE&G	1	RFC	25 MW ea.	25 MW
Metuchen	PSE&G	2	SFC	30 MW ea.	60 MW
Richmond	PECO	5	DC Link SFC	36 MW ea.	180 MW
Lamokin	PECO	3	RFC	20 MW ea.	60 MW
Safe Harbor	Brookfield	2	Hydro-Gen	32 MW ea.	64 MW
Safe Harbor	Brookfield	1	RFC	25 MW ea.	25 MW
Jericho Park	BG&E	2	Cyclo SFC	10 MW ea.	20 MW
Total		**20**			**464 MW**

Except for the 25 Hz single phase water wheels, all other power is provided by the means of frequency converters onto the 25 Hz Amtrak electrification system. The supply voltage from the utilities is supplied at various nominal voltages. (13.8 kV, 69 kV, 138 kV or 230 kV.) The Load Dispatcher is responsible for maintaining a steady state system condition, the monitoring and control of system voltage, and meeting load requirements for the propulsion of electric trains.

Generation from each station is scheduled to provide for a demand output capacity, for different blocks of time, within a 24-hour period. Jericho Park, Richmond, Metuchen (SFCs only), and Sunnyside static frequency converters are controlled by an independent SCADA system in the Load Dispatcher Office. The remaining stations are monitored by the Load Dispatcher but operated via local control by utility station operators.

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3.2 STEP-UP SUBSTATIONS

Step-up substations are located near the generation sources. They consist of an arrangement of switchgear, breakers, and transformers that step-up power from 13.2 kV to 138 kV (line to line, single phase) for transmission onto Amtrak lines. Amtrak Load Dispatchers and Power Directors often interact with utility company personnel for switching and maintenance at the step-up stations. Figure 3-4 below shows the Lamokin Step-Up Yard.

Figure 3-4. Lamokin Step-Up Yard

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Step-Up Transformers

Step-up transformers provide the means to step-up power generation from 13.2 kV – 138 kV for transmission and transmit (138 kV) power from the step-up stations out to the Amtrak power transmission system.

Step-up transformers typically have three high side bushings. An “A” & “B” phase at (69 kV) each and a neutral bushing. The neutral bushing is the central point of each transformers high voltage winding and is connected to the neutral ground resistor (NGR) which is connected to ground by a 330-ohm resistance. The (NGR) is part of a relay protection scheme which in case of a transmission line ground, limits the ground current to 200 amperes. Below in figure 3-5 is a picture of a step-up transformer at Lamokin.

Figure 3-5. Lamokin Step-Up Transformer

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Table P-2 lists the data for the step-up stations that supply the Amtrak electrification system.

Table P-2. Step-Up Station Data

Location	Transformer	Rating	Line Fed
Jericho Park	11	25 MVA	123
	22	25 MVA	223
Safe Harbor	P2	20 MVA	11
	P3	20 MVA	32
	P4	20 MVA	41
	P5	20 MVA	52
	P6	20 MVA	61
	P7	20 MVA	71
	P8	20 MVA	82
Lamokin	51S	20 MVA	112
	4	20 MVA	112A/212A/102
	62	20 MVA	211
	12	20 MVA	211/102
	11	20 MVA	111A
	52	20 MVA	211A
	51N	20 MVA	111/102
Metuchen	11	20/ 24 MVA	138
	23	20/ 24 MVA	338
	24	20/ 24 MVA	438
	32	20/ 24 MVA	238

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3.3 POWER TRANSMISSION

The Amtrak (138 kV) power transmission system consists of approximately 940 miles of transmission lines and 10.5 miles of vaulted or underground cable. From the step-up stations, the transmission conductors, two phases each line of 4/0, 7-strand copper, or equivalent conductor, tap onto the system at supporting structures classified as poles or structures. The lines are attached to a cross arm at the top of the structures by transmission suspension insulators that typically consist of 11 or 13 porcelain or composite bells.

The majority of transmission lines are aerial and along the right of way, however in some areas they may be overland for some distances, vaulted, or underground due to certain limitations or restrictions. As is the case of the (138 kV) solid dielectric in the B&P and Union Tunnels in Baltimore, MD that extends from Appleton St. (121, 221 lines) on the South end, to Bond St. (120 & 220 lines) on the North end.

The (138 kV) transmission network is segregated at three locations by normally open air break tie switches. They are located at Sub 16 Perryville (176 and 276), Lamokin Step-Up Station (621, 22A, 415, 11A) and Sub 30 Frankford (22HT). There are also (138 kV) phase breakers located at Perryville and Thorndale. This configuration is necessary to isolate different sources of power and prevent cascading unscheduled outages on the system. The protective relays for the (138 kV) phase breakers (R19 and R29) at Sub 9 Zoo have been removed. The breakers only function as sectionalizing devices. Figure 3-6 below shows a portion of the 25 Hz transmission system.

Figure 3-6. 25 Hz Transmission System

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3.4 STEP-DOWN SUBSTATIONS

Along the right of way (ROW) step-down substations are strategically located 8-10 miles apart for secondary distribution of power to the (12 kV) catenary system, for the propulsion of electric trains. The (138 kV) transmission lines enter the substations through an arrangement of (138 kV) air break and air break tie switches that provide the means to sectionalize, ground, or reconfigure sections of the transmission network.

Droppers tap off the (138 kV) bus to the high side switches that are used to isolate the primary side of the (4500 kVa) step-down transformers. There the voltage is transformed by mutual induction to the secondary winding to obtain a nominal (output) voltage of 12 kV, roughly an 11.5 to 1 ratio. A low side breaker protects the secondary side of the transformer from fault current flowing back from the (12 kV) bus section and protects the bus section from fault current flowing from the transmission line or transformer internal fault. A typical arrangement is a single transformer being fed from a single transmission line, to a respective (12 kV) bus section. There are normally two or more (12 kV) single bus sections connected through bus tie breakers (BB) that maintain continuity of the catenary circuits through the station. This continuity is sometimes referred to as being the third or fifth (NYD Division) transmission circuit.

Trolley breakers are connected to the (12 kV) bus sections through a set of bus and feeder (B&F) disconnects, which isolate the trolley breakers from the bus section and trolley taps. The trolley tap is made through the trolley (T) disconnect; however, some locations may also have a line (L) switch in a circuit that is being fed at some distance from the substation. Figure 3-7 shows a simple one-line drawing of a step-down substation. Figure 3-8 is a picture of Sub 64 Frazer on the Harrisburg line.

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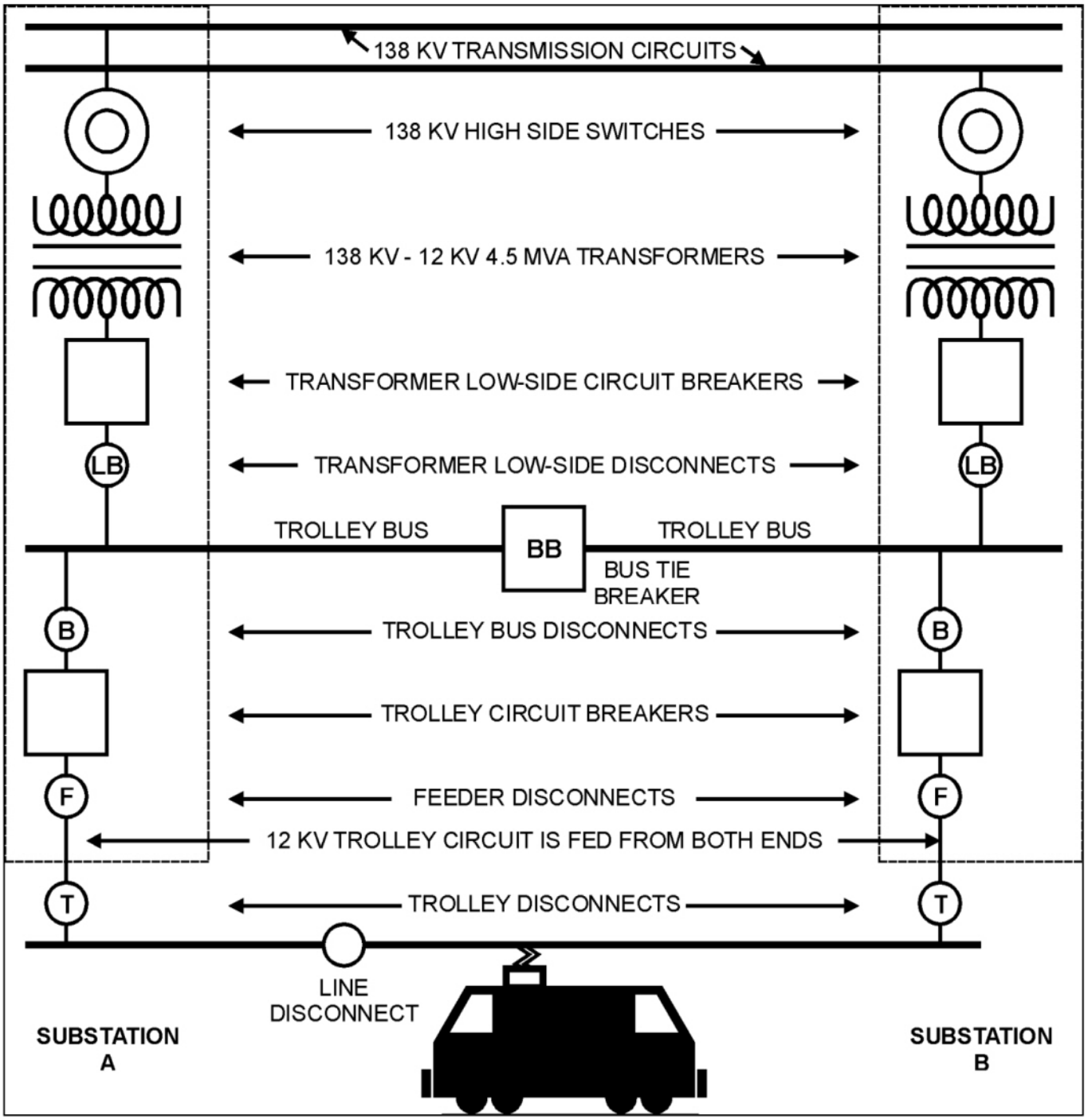

Figure 3-7. 25 Hz 1ϕ Step-Down Substation Configuration

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Figure 3-8. Sub 64 Frazer

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3.5 SWITCHING STATIONS

Switching stations are an arrangement of feeders, breakers and switchgear designed to maintain continuity or isolate between substations and strategically located in high volume traffic areas where it may not be practical or necessary to have power transformers. Switching stations are locations normally fed by two or more feeders, either lines or cables that deliver the primary source of power to the station bus sections. A typical location may have a group of Master breakers that feed a Low Rupture bus section and subsequent low rupture circuits (I.E. Sub 25A Union and Sub 43 Penn Station 31st and 7th Ave.).

Relay protection is set up so that a fault trips the Master breaker and the Low Rupture breaker associated with the faulted circuit. The Master breaker will re-close automatically after the faulted Low Rupture breaker (LRB) is cleared; thus, restoring power to the remaining LRBs connected to that bus section. Sub 03 Bryn Mawr, Sub 06 North Philadelphia and Sub 44 Sunnyside are also examples of switching stations but there is no Master – Low Rupture breaker set-up. These switching stations provide power to the (12 kV) bus sections via trolley circuits energized from adjacent step-down substations. Figure 3-9 is a picture of Sub 44 Sunnyside.

Figure 3-9. Sub 44 Sunnyside

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3.6 CATENARY SYSTEM

The 1ϕ, 12 kV, 25 Hz overhead catenary system between Queens, NY and Washington, DC as well as Philadelphia to Harrisburg, PA is comprised of several different design types and configurations according to location and application. Typically, a two or three wire arrangement supported under tension at structures by hardware and isolated by insulators, sectionalizing switches, section and phase breaks. The contact or riding wire allows for the continuous collection of current from the pantograph carbon strips mounted to the train. The rail return allows for a path from the rail back to the substations for the return current to complete the path of the electrical circuit. Figure 3-10 below is a typical 25 Hz fixed tension catenary system.

Figure 3-10. Typical 25 Hz Fixed Tension Catenary System

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Section Breaks

Section breaks allow for the smooth transition from one electrical circuit to another and are only electrically connected when the pantograph is bridging both sides of the break, or jumpered at a sectionalizing switch. Figure 3-11 below shows a section break.

Figure 3-11. Section Break

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Phase Breaks

Phase breaks provide the means to isolate different sources of power that may not be synchronous and should not be electrically connected at that location. The trolley breakers at Perryville and Thorndale are normally closed. When a phase break indicator (Rosette) is lit, the Train Dispatcher shall be notified immediately. Figure 3-12 below shows the phase breakers at Perryville.

Figure 3-12. Phase Breakers at Perryville

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Interlocking Locations

Interlocking locations are strategically located to provide for the diversion of train traffic and the isolation of catenary circuits relative to the track with sectionalizing switches. Figure 3-13 below is D section at 34th Street Philadelphia.

Figure 3-13. D Section at 34th Street Philadelphia

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Impedance Bonds

Impedance bonds are located in the track gage near the substations and impede the flow of signal circuit current and allow for the continuous flow of rail return current. Figure 3-14 shows an impedance bond.

Figure 3-14. Impedance Bond

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3.7 SIGNAL POWER SYSTEM

The signal power system operates at a frequency of 91 2/3 Hz or 100 Hz that is transmitted at 2300V (Hackensack to Gate)-3300V (Zoo to Paoli)- 6900V to 7200V (Washington, DC to Hackensack, NJ and Philadelphia to Harrisburg, PA) via cable or bare conductor suspended from the support structures or buried along the ROW. Primary power for the signal system originates at substations or locations equipped with rotating and/or solid-state frequency converters (signal machines), as shown in Figure 3-15, that utilize a 25 Hz or 60 Hz – 440V input to a motor that drives a 91 2/3 Hz or 100 Hz – 440V generator. The output of 91 2/3 Hz or 100 Hz signal power is then transformed to the desired voltage for transmission out to the signal power system. Signal feeder and tie breakers protect the equipment and line segments and direct the feed to achieve the desired configuration for each segment of the signal power system. The system is designed to respond and operate automatically in case of a fault or failure at either end of a particular segment.

If an undervoltage condition is indicated due to fault or failure, an adjacent tie or feeder breakers will sense this condition and respond by closing automatically if not locked out. Lock out relays on the feeder and tie breakers allow the Power Director to maintain more control under these conditions thereby not allowing the system to feed continuously into a fault.

Cut sections and signal locations are strategically located to tap off of the primary signal power line and provide the 110V/220V power via a step-down transformer for communication and signal functions (C&S) as well as a means to sectionalize and isolate segments of signal power system. The C&S Department is responsible for the secondary side. Figure 3-16 on the next page is a cut section at Cork Interlocking on the Harrisburg line.

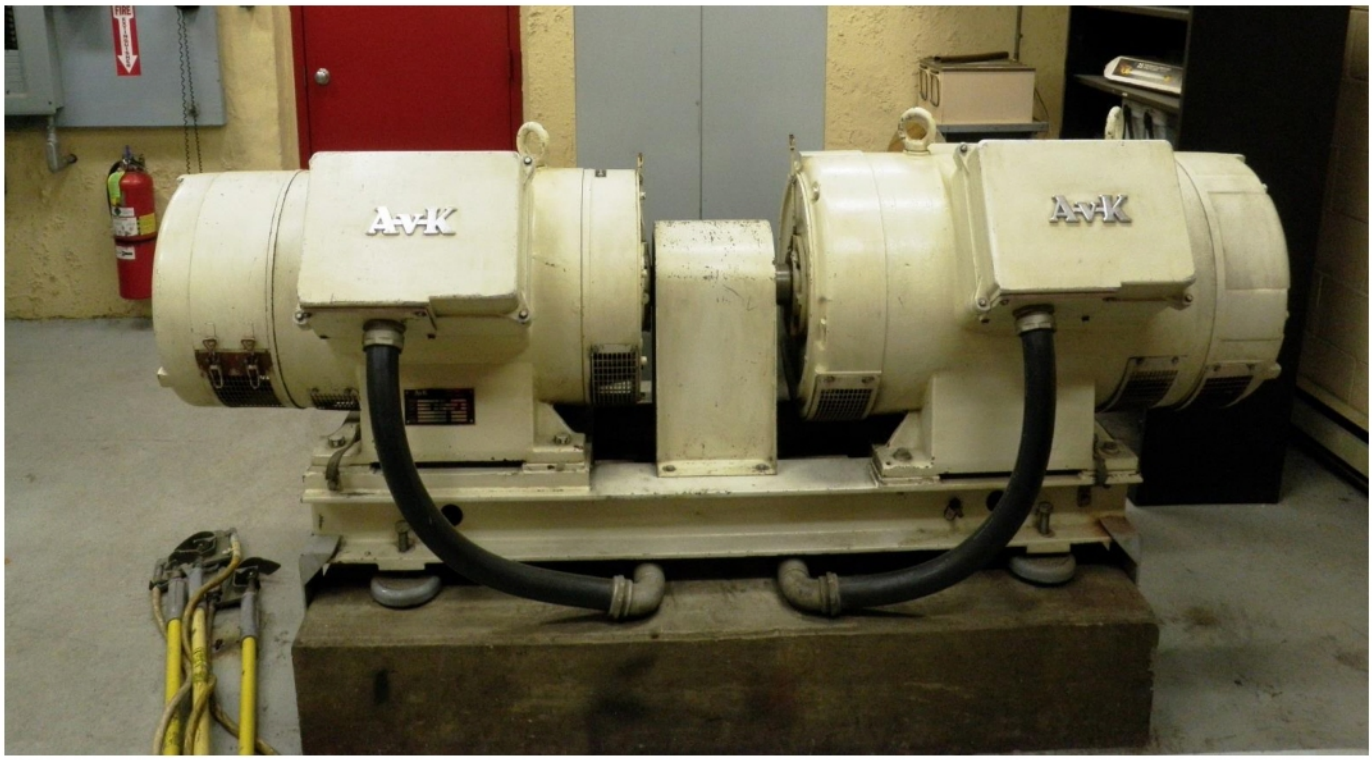

Figure 3-15. Signal Machine

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Figure 3-16. Cut Section at Cork Interlocking

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SECTION 4
THIRD RAIL ELECTRICIFICATION SYSTEM OVERVIEW

In addition to the overhead catenary system, Amtrak maintains a Third Rail system in the New York terminal area to serve Amtrak's Empire line dual-mode (diesel/third rail) trains as well as Long Island Railroad Third Rail trains. Amtrak's Third Rail territory extends from the North River Tunnels into Penn Station, NY through the East River Tunnels to Harold Interlocking and Sunnyside Yard. A short segment of Third Rail also exists through the North Access Tunnel for the Empire Connection. Figure 4-1 shows an Amtrak train on the Empire line in route to Niagara Falls.

Figure 4-1. Amtrak Empire Service Train Passing Philipse Manor Train Station in Route to Niagara Falls

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The primary difference of the Third Rail system is the use of direct current (DC) rather than the more commonly used alternating current (AC). Because of this, the substation design is different. Incoming commercial power supply is three phase AC, but after being stepped down by a station transformer the power is then changed to DC by means of a rectifier. 750V DC power is then distributed through substation breakers and onto the Third Rail system. Figure 4-2 below illustrates the Third Rail system's components.

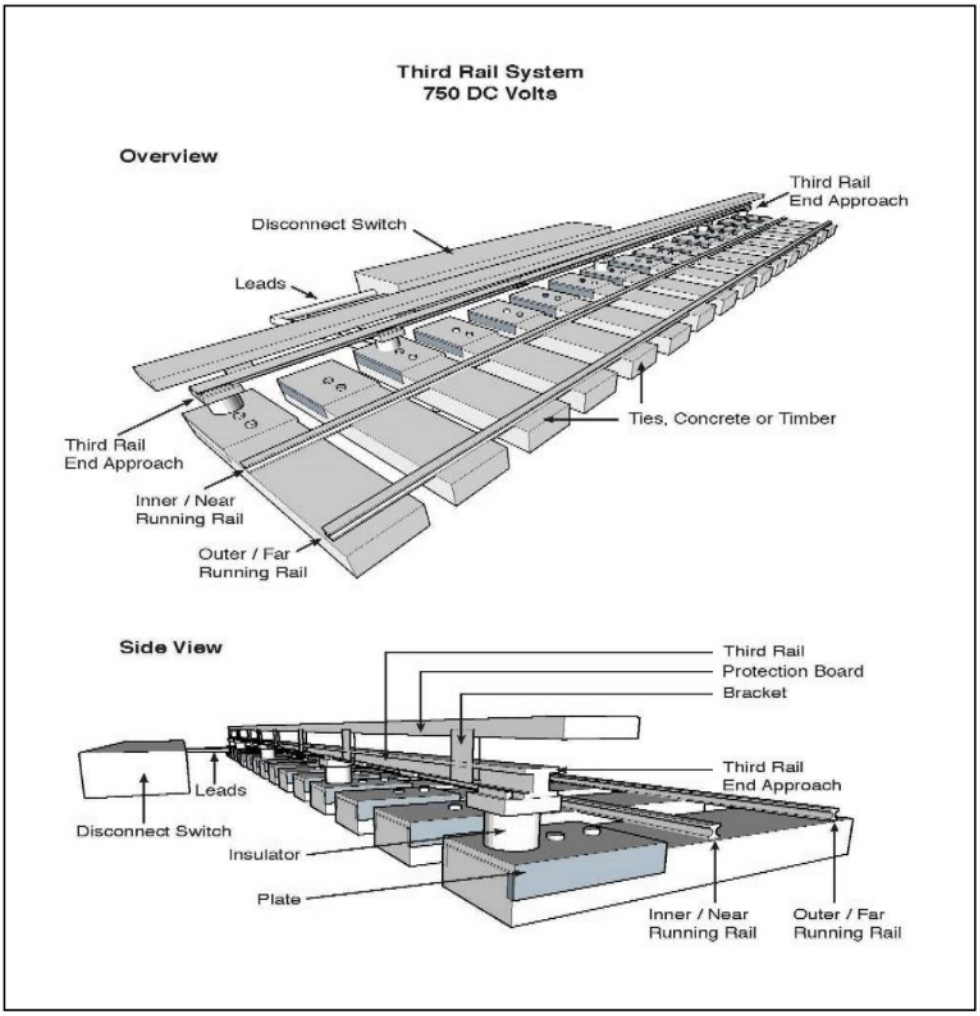

Figure 4-2. Third Rail System Components

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SECTION 5
HELLGATE ELECTRIFICATION SYSTEM OVERVIEW

The Hellgate section of Amtrak's electrification system spans from the phase breaks at Gate to the phase breaks at New Rochelle. This section is approximately 13 miles long. The section is energized at 1ϕ,12.5 kV – 60 Hz. There is a feeder and trolley for each circuit with the trolley to feeder voltage at 25 kV. The trolley or feeder voltage to ground is 12.5 kV. It is a two-track operation with one interlocking. This section of the electrification is under the control of the Zone 1 Power Director located in Midtown Manhattan.

The electrified portion of the Northeast Corridor extends beyond New Rochelle, NY to New Haven, CT. Amtrak operates trains over the route, however; this section of the Northeast Corridor from New Rochelle, NY to New Haven, CT is owned and maintained by Metro-North Commuter Railroad. This section is electrified at 1ϕ, 12.5 kV, 60 Hz power. Amtrak is Metro-North's tenant over this segment. Amtrak has no operating or maintenance responsibility for the Metro-North owned section.

To better understand the entire scope and operation of the Hellgate section of the electrification system, it is helpful to view and study the system as being comprised of the following four elements independently:

1. Power Supply
2. Paralleling Stations
3. Catenary System
4. Signal Power System

5.1 POWER SUPPLY

The 1ϕ, 12.5 kV, 60 Hz Hellgate system between Gate and New Rochelle is supported by only one electrical substation; Sub 46 Van Nest. Power is received from Con-Edison via two (138 kV) transmission lines. The power is stepped down to 12.5 kV by the means of two- 22.5 MVA transformers. The transformers are both equipped with a high side and low side oil circuit breakers. Both high side oil circuit breakers (OCB) are closed. One low side OCB is open and one low side OCB is closed to energize a bus section. There are four trolley/feeder circuits off the bus. There are two circuits between Sub 46 Van Nest and Sub 45 Bowery Bay. There are two circuits between Sub 46 Van Nest and Sub 47 New Rochelle. Figure 5-1 on the next page is a picture of Sub 46 Van Nest.

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Figure 5-1. Sub 46 Van Nest

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5.2 PARALLELING STATIONS

There are two paralleling stations on the Hellgate; Sub 45 Bowery Bay and Sub 47 New Rochelle. Each station contains one BT breaker and two autotransformers, one per circuit. The BT will open on a fault to isolate the faulted circuit. Figure 5-2 below is a picture of Sub 47 New Rochelle.

Figure 5-2. Sub 47 New Rochelle

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5.3 CATENARY SYSTEM

The overheard catenary on the Hellgate is of the fixed tension type. It is a three-wire construction, consisting of a messenger, trolley, and an auxiliary wire. Figure 5-3 below is an Amtrak train on the Hellgate system.

Figure 5-3. Amtrak Train on the Hellgate

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5.4 SIGNAL POWER SYSTEM

The signal power is provided by two signal machines. The signal machines are located at Sub 45 Bowery Bay and Sub 47 New Rochelle. The machines have a 480V – 60 Hz input, which is provided by Con-Ed. The output of the machines is 480V – 100 Hz. The power is stepped up to 7200V for transmission over the 13 miles of signal line. The power is stepped down at strategic locations for use in signal circuits. Figure 5-4 shows the signal line on the Hellgate system.

Figure 5-4. Hellgate Signal Line

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SECTION 6
60 HZ NORTH END ELECTRIFICATION SYSTEM OVERVIEW

To better understand the entire scope and operation of the 60 Hz North end electrification system, it is helpful to view and study the system as being comprised of the following five elements independently:

1. 60 Hz Power Supply
2. Step-Down Substations
3. Paralleling Stations
4. Switching Stations
5. Catenary System

6.1 60 HZ POWER SUPPLY

The 1ϕ, 25 kV, 60 Hz system between New Haven, CT and Boston, MA is made up of eight independent electrical sections supported by four substations, spaced approximately 40 miles apart at Branford, CT; New London, CT; Warwick, RI; and Sharon, MA. There are two utilities that provide the interconnections to these four substation locations. These utilities are:

- Ever Source provides the 60 Hz/115 kV utility taps for the 2-40 MVA, 115/25 kV, 1ϕ transformers at Sharon Substation in Sharon, MA.
- National Grid which provides the 60 Hz/115 kV utility taps for the 2-40 MVA, 115/25 kV, 1ϕ transformers at Warwick Substation in Warwick, RI.
- Ever Source which provides the 60 Hz/115 kV utility taps for the 2-40 MVA, 115/25 kV, 1ϕ transformers at New London Substation in New London, CT.
- Ever Source which provides the 60 Hz/115 kV utility taps for the 2-40 MVA, 115/25 kV, 1 ϕ transformers at Branford Substation in Branford, CT.

The transmission lines feeding the four substations on the New England Division belong to two supplying utilities. Between the four substations, there are three switching stations and eighteen paralleling stations spaced approximately four miles apart to provide additional support. These stations are needed to provide the means to maintain voltage levels and reduce the line losses between substations using autotransformers as well as paralleling the trolley circuits to maintain balance and even distribution of power resources. Because the Northeast Corridor between New Haven, CT and Boston, MA uses a 60 Hz power supply, there is no need for frequency converter stations in this part of the system.

6.2 STEP-DOWN SUBSTATIONS

As mentioned above, in the North end of the Northeast Corridor, utility taps are supplied from the two utility companies to the four substations as single phase 60 Hz power at a nominal voltage of 115 kV. Providing full redundancy, power is supplied to each section by a separate 40 MVA traction power supply transformer at the substations and supported by the 10 MVA autotransformers at paralleling and switching stations within each section. All power and autotransformers are center tapped to the rail return system and ground potential. The traction power supply transformers are fitted with load tap changers, which automatically maintain the system voltage within the specified operating limits.

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Each 40 MVA traction power supply transformer can support the entire station requirements without service impacts. Power is supplied to the overhead catenary system directly from the substations via individual circuit breakers; and indirectly through a negative feeder system supplying the eighteen paralleling stations and three switching stations within each section. The catenary to feeder voltage is 50 kV and catenary or negative feeder to rail voltage is 25 kV.

Substation spacing is approximately 40 miles apart. The utility company owns, operates, and maintains that portion of the substation components from the high side bushing of the 40 MVA traction power transformers back to the incoming high voltage feeders. All other substation components are owned, operated, and maintained by Amtrak.

The (115 kV) lines enter the substation via line or cable and connect to the primary bushings of the 115-kV/25 kV step-down transformers. The transformers are protected on the primary side by SF6 gas circuit breakers or high side switches, and low side breakers on the secondary side. The transformer secondary winding has a center tap for the rail return, referencing ground potential. The nominal voltage on the secondary side is 25 kV from negative feeder to rail or catenary to rail, and 50 kV from catenary to negative feeder. The (25 kV) conductors enter the indoor substation enclosure via cable and connect to the low side breakers and then distributed to their respective (25 kV) bus sections. The bus tiebreakers are normally open to isolate the different sources of power which are out of phase.

Electric interlocks prevent the closing of any equipment that would connect separate power sources that may not be in phase. The distribution schemes for each substation are practically identical with one low side breaker, two trolley breakers, one service transformer and breaker per bus section. Outside the switch gear and control room enclosure adjacent to the right of way is a Gantry which has a series of motorized trolley/feeder and tie switches that offer flexibility for maintenance, sectionalizing and providing alternate feeds when required. A trolley/feeder ground switch and lightning arrester is also located on the gantry between the trolley breaker and the trolley feeder disconnects.

Located within the phase break of the overhead catenary system, there is a normally open motor operated phase break switch that is connected to the overhead catenary system on each track to electrically isolate the separate power sources.

Each device in the substation can be put in local control independent of each other. Power for control and indication status of equipment is achieved with a 125V DC battery bank and solid-state charger. A 25 kV to 110/220V step-down service transformer is connected to each bus section for station auxiliary functions. Figure 6-1 on the next page is a picture of Sub 86 Sharon.

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Figure 6-1. Sub 86 Sharon

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6.3 PARALLELING STATIONS

Paralleling stations are located between substations and switching stations and spaced approximately 4-7 miles apart. The eighteen stations provide the means to maintain voltage levels and reduce the line losses between substations using autotransformers. Additionally, paralleling the trolley circuits maintains balance and even distribution of power resources. Stations are identical except for Roxbury where there is a third main line track supported by an additional parallel breaker and autotransformer. Typically, there is a trolley breaker, motor operated trolley feeder disconnect switch, low side breaker and autotransformer for each circuit. Under normal system conditions the trolley circuits are in the parallel configuration. Figure 6-2 below is a picture of 84B Providence.

Figure 6-2. 84B Providence

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6.4 SWITCHING STATIONS

Switching stations are spaced approximately 50 miles apart, located at the midpoint between substations and isolate the separate power sources on each side. The overhead catenary system circuits between the substation and a switching station consist of the elementary electrical sections as defined by the fault location and isolation system logic. In sections, where loading has been determined to be substantially higher, an additional autotransformer has been added to support these areas between Westbrook and Richmond. Figure 6-3 is a picture of W83 Richmond.

Figure 6-3. W83 Richmond

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6.5 CATENARY SYSTEM

The North end overhead catenary system is a constant tension two wire (messenger and contact wire), design that compensates for changing temperature conditions with an overlap to balance weight arrangement for every one mile of catenary with the exception of South Hampton Street Yard which is a single wire system (contact wire only). Cantilever catenary poles approximately 35 feet tall and spaced approximately 70-200 feet apart are used to support the overhead catenary system. Catenary pole spacing is closer than normal on the New England Division to allow for the constant tension high speed operation. A mid-point anchor is a fixed point located between the set of balance weights for each catenary circuit. Adjustable stops are located within the pull-off arrangement at the balance weights and are set to allow for a registration arm movement of 12 inches before locking up in either direction coincident to changes in temperature. However, the system is designed to operate between -10^{o}F and 110^{o}F without lockup. Figure 6-4 below shows a typical balance weight assembly. Maintenance to hinged points and pulleys are critical to the operation of a constant tension system. Figure 6-5 on the next page shows the North end constant tension catenary system.

Figure 6-4. Typical Balance Weight Assembly

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Figure 6-5. North End Constant Tension Catenary System

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USING THE POWER DIRECTOR OPERATING GUIDELINES MANUAL

This Operating Guidelines Manual is a compilation of tasks relating to the operation of Amtrak's electrification system by the Power Directors. Each task is intended as a guideline only; each task will likely have to be modified to match each specific scenario in which it is used.

The manual is organized into 7 functional areas, each of which contains task outlines relating to the specific functional area.

In the case of a new Operating Guideline, the Senior Manager of System Operations- Electric Traction will assign a number to the new Operating Guideline, using the format: XXX-Y. Where XXX is the functional area and Y is the next sequential number. Numbers for an Operating Guideline will start with 1.

The following series are the functional areas for which a new Operating Guideline will be assigned.

- PDE Power Director Office Evacuation
- STO Shift Turnover
- FAR Forms and Reports
- SUB Substation Operation
- TRO Trolley Distribution System
- SCA SCADA Operation
- ESO Emergency System Operation

A listing of the tasks covered in each functional area may be found in the Table of Contents, as well as on the cover page for each functional area.

To use this manual, locate the task in the functional area containing the desired action. Then, simply follow the instructions. Keep in mind that no task can possibly cover every single scenario that will be encountered by a Power Director. However, if the provided tasks are modified as necessary to meet a scenario's circumstances, the tasks will fit all scenarios.

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TITLE: TABLE OF CONTENTS

Power Director Office Evacuation Tasks (PDE)

Guideline	Version	Date	Title
PDE-1	00	02.14.17	Evacuating the Power Director Office
PDE-2	00	02.14.17	Returning to the Power Director Office

Shift Turnover Tasks (STO)

Guideline	Version	Date	Title
STO-1	01	10.07.19	Performing a Shift Turnover
STO-2	01	10.07.19	Receiving a Shift Turnover
STO-3	01	10.07.19	Performing a Review of Operating Zone
STO-4	00	10.07.19	Maintaining Shift Turnover Report

Forms and Reports Tasks (FAR)

Guideline	Version	Date	Title
FAR-1	00	04.14.17	Maintaining Power Director Logbook
FAR-2	00	01.01.19	Requesting Vacation
FAR-3	00	08.19.19	Maintaining Out of Service Equipment Log
FAR-4	00	03.02.20	Maintaining Clearance Form NEC.84

Appendix

Guideline	Version	Date	Title
A	01	01.01.19	Glossary
B	00	04.07.17	Abbreviations and Acronyms

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FOREWORD

The attached are the Amtrak Electric Traction Power Director Operating Guidelines. These guidelines should be used to assist Electric Traction Power Directors in the safe and efficient performance of their duties within the Electric Traction Department.

These guidelines make no attempt to anticipate all possible job circumstances. Special conditions will require that each employee utilize his or her experience and skills to work productively towards resolution of potential problems. These guidelines shall not restrict the initiative of any employee to develop improved methods of operation and are not a substitute for common sense and good judgment.

Whenever you are aware of an error with any of these guidelines, please notify the Senior Manager of System Operations– Electric Traction. Improvement to these guidelines will be made on a regular basis incorporating your comments and concerns.

A new Table of Contents will be issued with each new or revised Operating Guideline entry, documenting which Operating Guideline has been updated, the date revised, the version number and the reason for the change.

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SUMMARY OF CHANGES

Date	Guideline	Page(s) Affected	Reason For Change
12.23.21	Preface	9, 10, 11 14 16, 17 52	Amtrak Core Values & Safety Starts with me program Added New York- West division HQ in Trenton, NJ Updated Zones 1, 2/3, 4 & 8 geographical limits Added SCA- SCADA Operation category
03.02.20	FAR-4	All	Issued Maintaining Clearance Form NEC.84
10.07.19	STO-1, STO-2	All	Updated Performing and Receiving Shift Turnover to reflect addition of Shift Turnover Report, current operating reports
10.07.19	STO-3	All	Updated definitions and references Included review of active ET letters and memos
10.07.19	STO-4	All	Issued Maintaining Shift Turnover report
08.19.19	FAR-3	All	Issued Maintaining Out of Service Equipment log
01.01.19	FAR-2	All	Issued Requesting Vacation
01.01.19	Appendix A	All	Updated Glossary to reflect new AMT-2 release on 01.01.19
04.14.17	FAR-1	All	Issued Maintaining Power Director Logbook
04.07.17	STO-1	All	Issued Performing a Shift Turnover
04.07.17	STO-2	All	Issued Receiving a Shift Turnover
04.07.17	STO-3	All	Issued Performing a Review of Operating Zone
04.07.17	Appendix B	All	Added Abbreviations and Acronyms
02.14.17	PDE-1	All	Issued Evacuating the Power Director Office
02.14.17	PDE-2	All	Issued Returning to the Power Director Office
01.30.17	Appendix A	All	Added Glossary
01.20.17	Preface	All	Added Preface for the Power Director Operating Guidelines

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Officially the Governor Michael S. Dukakis Transportation center at South Station, Amtrak's South Station, as shown is figure 1-1, is located at 2 Summer & Atlantic Avenue Boston, MA. 02110.

Figure 1-1. Amtrak's South Station

It is the largest railroad station and intercity bus terminal in greater Boston and New England's second largest transportation center after Logan International Airport. The historic station building was constructed in 1899 to replace the downtown terminals of several railroads.

Today, it serves as a major intermodal domestic transportation hub, with service to the greater Boston region and the Midwestern and Northeastern United States. It is used by thousands of commuter rail and intercity rail passengers daily. Connections to the rapid transit Red Line and Silver Line are made through the adjacent subway station.

Amtrak's Power Director Office is located on the fifth floor of South Station. Power Directors coordinate all activities related to the operation of Amtrak's 60 Hz electrification system between New Haven, CT and Boston, MA. They perform a critical role in the Electric Traction Department for Amtrak. This office contains a control board that displays the condition of high voltage circuits and equipment relating to Amtrak's 1ϕ, 25 kV, 60 Hz electrification system. This allows the Power Directors information to make adjustments based on constantly changing conditions. The functionality of this office is critical to the continued operation of Amtrak trains. This section will focus on the tasks that the Power Director performs when evacuation of the Power Director Office is required.

PDE-1 **Evacuating** the Power Director Office.
PDE-2 **Returning** to the Power Director Office.

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PDE-1 EVACUATING THE POWER DIRECTOR OFFICE

1.0 TASK OBJECTIVE

Respond to an evacuation of the Power Director Office by gathering necessary information and notifying required personnel.

2.0 RECOMMENDED CONDITIONS

This task should be performed when the fire alarm sounds or an evacuation of the Power Director Office is required.

3.0 REFERENCES

- Contact List
- Prints
- Power Director Clearance Form (NEC.84)
- Amtrak Issued Cell Phone
- Appendix A. Glossary

4.0 POWER DIRECTOR ACTION

In the event the Power Director Office needs to be evacuated, the **Power Director:**

1. **Remains** calm.
2. **Writes** down time fire alarm sounded or evacuation was announced.
3. **Stops** work safely.
4. **Maintains** situational awareness.
5. **Gathers** following items when practical:
    - Contact list
    - Prints
    - Outstanding clearances
    - Amtrak issued cell phone
6. **Logs** off computers.
7. **Leaves** Power Director Office by nearest or safest stairwell.
8. **Proceeds** to Summer Street.
9. **Meets** at Stone & Webster Building.
10. **Stays** in the designated emergency assembly point until instructed otherwise.

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11. **Notifies** following that Power Director Office was evacuated:
    - Electric Traction personnel on property
    - Load Dispatcher Office

    NOTE: Notifying appropriate personnel allows those individuals an opportunity to engage any mechanism required to ensure a proper response is initiated.

12. **Awaits** "all clear" and re-entry signal from designated Amtrak representative that it is OK to return to Power Director Office.

13. If all clear and re-entry signal is delayed:

    13a. **Maintains** current appropriate evacuation safety procedures.

ATTENTION

Once the Power Director is in a safe environment, they can advise the field personnel of the Power Director's current situation and the Employee in Charge out in the field can determine if they can continue to work safely.

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PDE-2 RETURNING TO THE POWER DIRECTOR OFFICE

1.0 TASK OBJECTIVE

Resume duties of the Power Director after returning to the Power Director Office.

2.0 RECOMMENDED CONDITIONS

This task should be performed when the Power Director has returned to the Power Director Office.

3.0 REFERENCES

- Contact List
- Prints
- Power Director Clearance Form (NEC.84)
- Log Book.mdb
- Amtrak Issued Cell Phone
- SCADA Operating System
- Microsoft Outlook Mail
- Appendix A. Glossary
- Appendix B. Abbreviations & Acronyms

4.0 POWER DIRECTOR ACTION

After returning to the Power Director Office, the **Power Director:**

1. **Writes** down time Power Director has returned to office.
2. **Logs** back on computers.
3. **Reviews** and determines validity of alarms.
4. **Notifies** following that Power Director has returned to office:
    - Electric Traction personnel on property
    - Load Dispatcher Office
5. **Returns** following items to their proper place:
    - Clearances
    - Contact list
    - Prints
    - Amtrak issued cell phone
6. **Enters** time in Log Book that Power Director was absent from office.
7. **Sends** Email out with times Power Director was absent from office.

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Power Directors are required to perform a Shift Turnover, ensuring a smooth transition from one Power Director shift to the next. A Shift Turnover is a transfer of responsibility and information regarding the status of the operating zone from the outgoing to incoming Power Director. A smooth transition from one Power Director to the next is essential to ensure continued, safe and reliable operations.

The Shift Turnover involves a period of preparation by the outgoing Power Director. It must be valued by those in attendance and not considered meaningless. Information on a Shift Turnover would include but not limited to; any event in progress, outstanding clearances, equipment removed from or returned to service, changes in system configuration, scheduled work for the next tour of duty, personnel on property, signal power system set-up, and any unusual conditions including impending inclement weather. Key information needs to be specified and presented. Extra attention during a Shift Turnover is crucial when the incoming Power Director has returned following a lengthy absence from work or deviates from their normal tour of duty. A Shift Turnover is required to be both verbal and written.

The goal of a Shift Turnover is for the incoming Power Director to know as much about the status of the operating zone as the outgoing Power Director. This can only be accomplished with cooperation between both Power Directors. Two-way communication with feedback is essential at Shift Turnover with both Power Directors taking joint responsibility for ensuring accurate communication. This section covers tasks the Power Director performs related to Shift Turnover.

STO-1 **Performing** a Shift Turnover.
STO-2 **Receiving** a Shift Turnover.
STO-3 **Performing** a Review of Operating Zone.
STO-4 **Maintaining** Shift Turnover Report.

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STO-1 PERFORMING A SHIFT TURNOVER

1.0 INTRODUCTION

The Boston Power Director Office is a 24-hour 7 days a week operation covered in three shifts. At the end of each shift, the incoming Power Director assumes the shift from the outgoing Power Director. A smooth transition from one Power Director to the next is important to ensure continued, reliable operation of the Amtrak Electric Traction electrification system.

The goal of the outgoing Power Director is to help ensure that the incoming Power Director is properly informed with the status of the operating zone. This task focuses on the role of the outgoing Power Director during a Shift Turnover. Task STO-2 describes the role of the incoming Power Director.

2.0 TASK OBJECTIVE

Ensure incoming Power Director is adequately briefed on current system conditions including changes in system configuration, equipment that was removed from or returned to service, outstanding clearances and location of field forces. This will ensure a smooth transition from one Power Director to the next.

3.0 RECOMMENDED CONDITIONS

This task should be performed at the end of every shift, when the relief for the next shift is physically present and ready to assume the duties of the Power Director.

4.0 REFERENCES

- Shift Turnover Report.doc
- ET Log Book.mdb
- Power Director Office Schedule.xls
- Power Director Clearance Form (NEC.84)
- Power Director Work Permit Form (NEC.85)
- Out of Service Equipment.xls
- Track Usage Report
- SCADA Operating System
- Microsoft Outlook Mail
- Outage Scheduler in Microsoft Outlook Calendar
- ET Letters, Memos, and Standard Operating Instructions
- Appendix A. Glossary
- Appendix B. Abbreviations & Acronyms

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5.0 POWER DIRECTOR ACTION

With the incoming Power Director for the next shift physically present and ready to assume the duties of the Power Director, the outgoing **Power Director:**

1. **Presents** Shift Turnover report to incoming Power Director.
2. **Explains** status of outstanding clearances and work permits.
3. **Reviews** plate orders in effect.
4. **Describes** current events in progress.
5. **Describes** changes in system configuration.
6. **Adds** equipment removed or returned to service within last 72 hours.
7. **Names** ET personnel on property.
8. **Reviews** upcoming major scheduled outages.
9. **Describes** any anticipated event. (Personnel expected on property etc.)
10. **Reviews** active ET letters including memos or SOIs.
11. **Discusses** general information relating to Power Director Office.
12. **Informs** incoming Power Director of impending inclement weather.
13. **Identifies** mark-offs by field personnel.
14. **Provides** incoming Power Director with necessary resources including:
    - Shift Turnover Report.doc
    - Power Director Office Schedule.xls
    - ET Log Book.mdb
    - Issued or Pending Clearances and Work Permits
    - Out of Service Equipment.xls
    - Microsoft Outlook Mail
    - Track Usage Report
    - Outage Scheduler in Microsoft Outlook Calendar
    - SCADA Operating System
    - ET Letters, Memos and Standard Operating Instructions
15. **Answers** questions presented by incoming Power Director.

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STO-2 RECEIVING A SHIFT TURNOVER

1.0 INTRODUCTION

The Boston Power Director Office is a 24-hour 7 days a week operation covered in three shifts. At the end of each shift, the incoming Power Director assumes the shift from the outgoing Power Director. A smooth transition from one Power Director to the next is important to ensure continued, reliable operation of the Amtrak Electric Traction electrification system. The goal of a Shift Turnover is for the incoming Power Director to know as much about the status of the operating zone as the outgoing Power Director. This can only be accomplished with cooperation between both Power Directors.

The goal of the incoming Power Director is to learn the status of the operating zone and become as familiar with this status as the outgoing Power Director. This task focuses on the role of the incoming Power Director during a Shift Turnover. STO-1 described the role of the outgoing Power Director.

2.0 TASK OBJECTIVE

Become adequately briefed on system conditions including changes in system configuration, equipment that was removed from or returned to service, outstanding clearances and location of field forces. This will ensure a smooth transition from one Power Director to the next.

3.0 RECOMMENDED CONDITIONS

This task should be performed at the beginning of every shift, prior to assuming the responsibilities of the Power Director.

4.0 REFERENCES

- Shift Turnover Report.doc
- ET Log Book.mdb
- Power Director Office Schedule.xls
- Power Director Clearance Form (NEC.84)
- Power Director Work Permit Form (NEC.85)
- Out of Service Equipment.xls
- Track Usage Report
- SCADA Operating System
- Microsoft Outlook Mail
- Outage Scheduler in Microsoft Outlook Calendar
- ET Letters, Memos, and Standard Operating Instructions
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5.0 POWER DIRECTOR ACTION

Before assuming the duties and responsibilities of the Power Director, the incoming **Power Director:**

1. **Receives** Shift Turnover report from outgoing Power Director.
2. **Requests** outgoing Power Director for any clarification of current system conditions, including:
   - Current events in progress
   - Changes in system configuration
   - Equipment removed or returned to service since incoming Power Director's last shift
   - System outages or issues over last 24-48 hours
   - Status of outstanding clearances and work permits
   - Plate orders in effect
   - Personnel currently on property
   - Mark-offs by field personnel
   - Scheduled outages
   - Upcoming events
   - Inclement weather predicted
3. **Accepts** Shift Turnover from outgoing Power Director.

ATTENTION

Ask necessary questions of outgoing Power Director to ensure a complete understanding of current system conditions for the Operating Zone.

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STO-3 PERFORMING A REVIEW OF OPERATING ZONE

1.0 TASK OBJECTIVE

To accurately verify information within your assigned operating zone and become aware of any abnormal conditions to ensure continued safety, reliability and operation of the system.

2.0 RECOMMENDED CONDITIONS

This task should be performed at the beginning of every shift, after accepting the Shift Turnover from the outgoing Power Director.

3.0 REFERENCES

- Shift Turnover report.doc
- ET Log Book.mdb
- Power Director Clearance Form (NEC.84)
- Power Director Work Permit Form (NEC.85)
- Out of Service Equipment.xls
- Track Usage Report
- SCADA Operating System
- Microsoft Outlook Mail
- Outage Scheduler in Microsoft Outlook Calendar
- STO-4 Maintaining Shift Turnover Report
- ET Letters, Memos, and Standard Operating Instructions
- Appendix A. Glossary
- Appendix B. Abbreviations & Acronyms

4.0 POWER DIRECTOR ACTION

After accepting a Shift Turnover, the **Power Director:**

1. **Reads** ET Log Book.
2. **Reviews** following for accuracy:
    - Shift Turnover report
    - Outstanding clearances and work permits (issued and pending)
    - Tag list
    - Plate orders in effect
    - Out of Service Equipment log
    - Inhibited alarm summary
3. **Surveys** following for accuracy:
    - Catenary
    - Substation equipment
    - RTU status (substation and interlocking)

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4. **Reviews** active ET Letters and Memos.
5. **Reviews** following items in Outage Scheduler:
   - Scheduled outages on your shift.
   - Scheduled outages for incoming Power Director.
6. **Reviews** Track Usage sheet.
7. **Reads** Email for information pertaining to your operating zone.

ATTENTION

Pay close attention to scheduled work requested by Utilities when reviewing the Outage Scheduler.

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STO-4 MAINTAINING SHIFT TURNOVER REPORT

1.0 INTRODUCTION

The Shift Turnover report involves a period of preparation by the outgoing Power Director. Information on a Shift Turnover report would include but not limited to; any event in progress, outstanding clearances, equipment removed from or returned to service, changes in system configuration, scheduled work for the next tour of duty, personnel on property and any unusual conditions including impending inclement weather. Key information needs to be specified and presented. A Shift Turnover is required to be both verbal and written. Figure STO 4 -1 shows a blank Shift Turnover report.

The goal of a Shift Turnover is for the incoming Power Director to know as much about the status of the operating zone as the outgoing Power Director. This can only be accomplished with cooperation between both Power Directors. Two-way communication with feedback is essential at Shift Turnover with both Power Directors taking joint responsibility for ensuring accurate communication.
Figure STO 4-2 shows a properly filled out Shift Turnover report.

2.0 TASK OBJECTIVE

Enter all appropriate information into the Shift Turnover report to ensure a complete and accurate record of the system is maintained.

3.0 RECOMMENDED CONDITIONS

This task should be performed during every shift, when there is a change in status to the operating zone or information becomes available.

4.0 REFERENCES

- Shift Turnover Report.doc
- ET Log Book.mdb
- Power Director Office Schedule.xls
- STO-3 Performing a Review of Operating Zone
- Out of Service Equipment.xls
- Power Director Clearance Form (NEC.84)
- Power Director Work Permit Form (NEC.85)
- Track Usage Report
- SCADA Operating System
- Microsoft Outlook Mail
- Outage Scheduler in Microsoft Outlook Calendar
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POWER DIRECTOR SHIFT TURNOVER REPORT ZONE 10

Day: Choose a day **Date:** 12/16/2018 **Shift:** Choose Shift

Outgoing Power Director: Choose a name **Incoming Power Director:** Choose a name

OUTSTANDING CLEARANCES/WORK PERMITS
CURRENT EVENTS IN PROGRESS
CHANGES IN SYSTEM CONFIGURATION
EQUIPMENT REMOVED FROM SERVICE LAST 72 HOURS
EQUIPMENT RETURNED TO SERVICE LAST 72 HOURS
ET PERSONNEL ON PROPERTY
MAJOR SCHEDULED OUTAGES FOR NEXT SHIFT
UPCOMING EVENTS
ET LETTERS, MEMOS ISSUED LAST 72 HRS
GENERAL INFORMATION
INCLEMENT WEATHER CONDITIONS

Figure STO 4-1. Blank Shift Turnover Report

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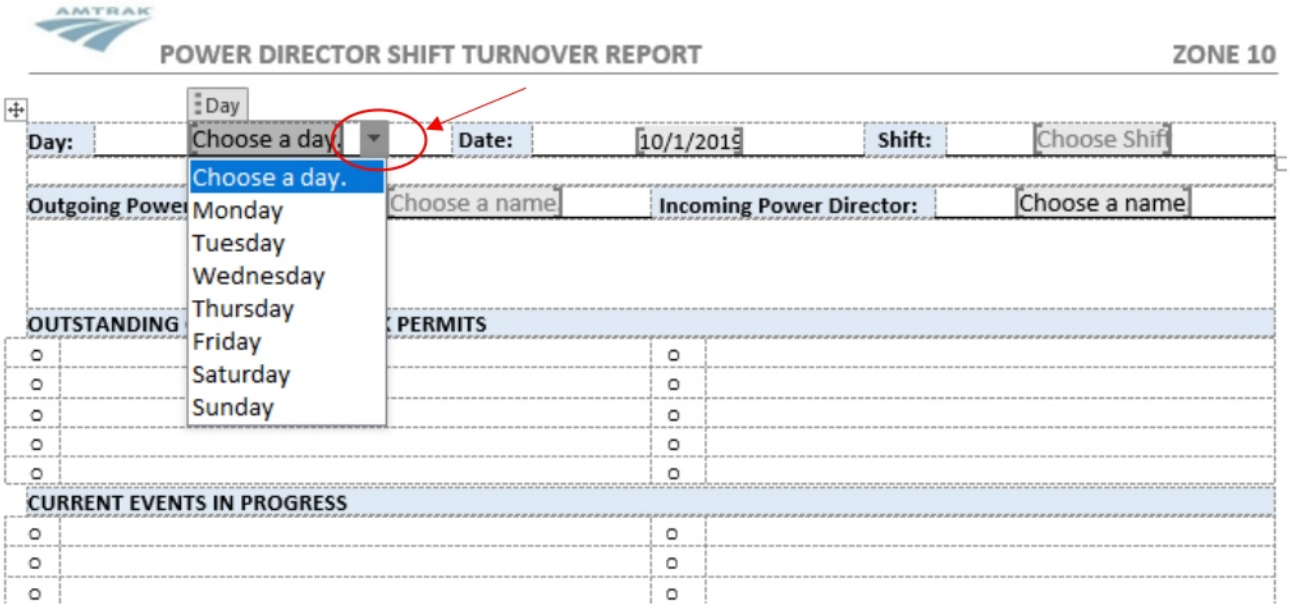
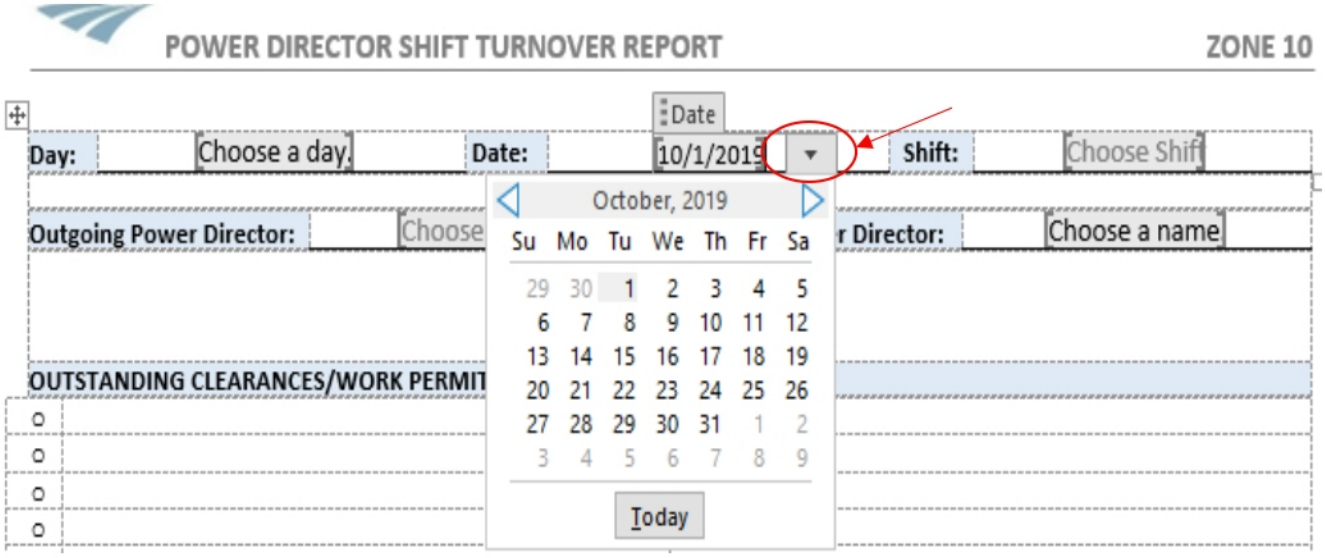
5.0 POWER DIRECTOR ACTION

To enter information into the Shift Turnover report, the **Power Director:**

1. **Opens** Shift Turnover report.doc
2. **Selects** "Day" of report.



3. **Selects** "Date" of report.



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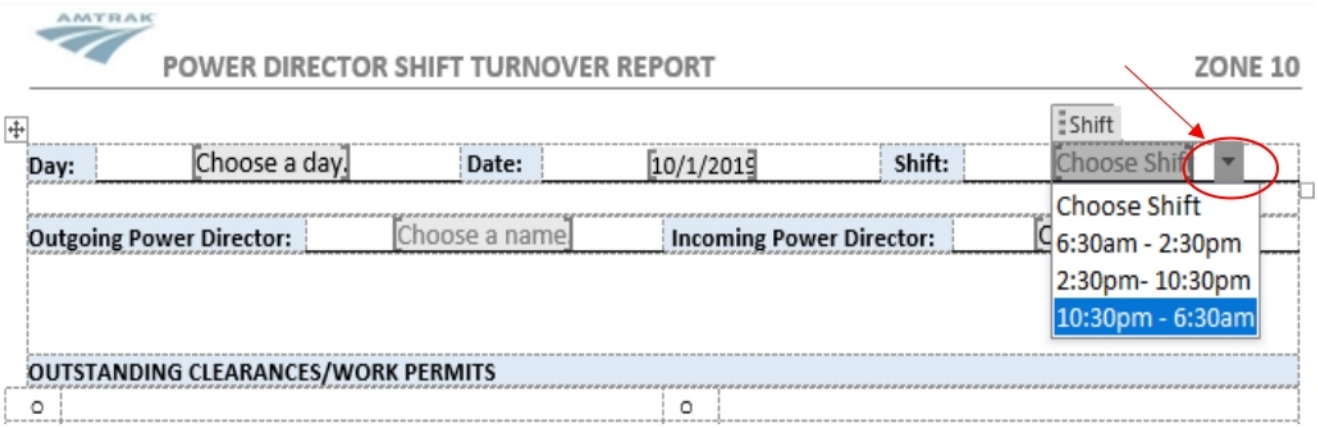
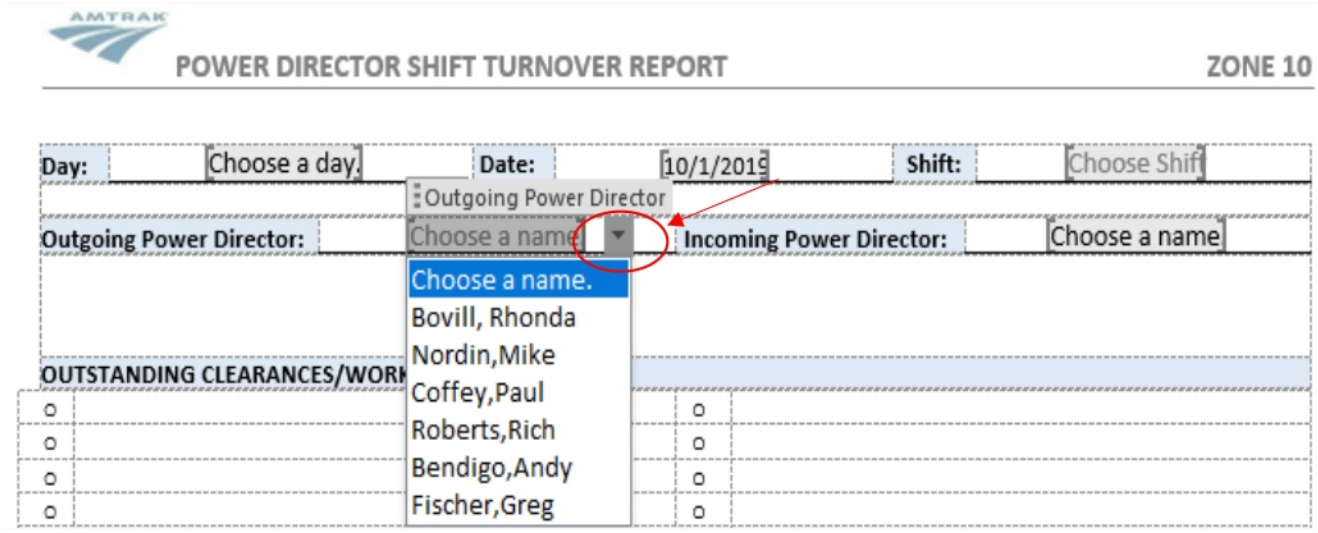
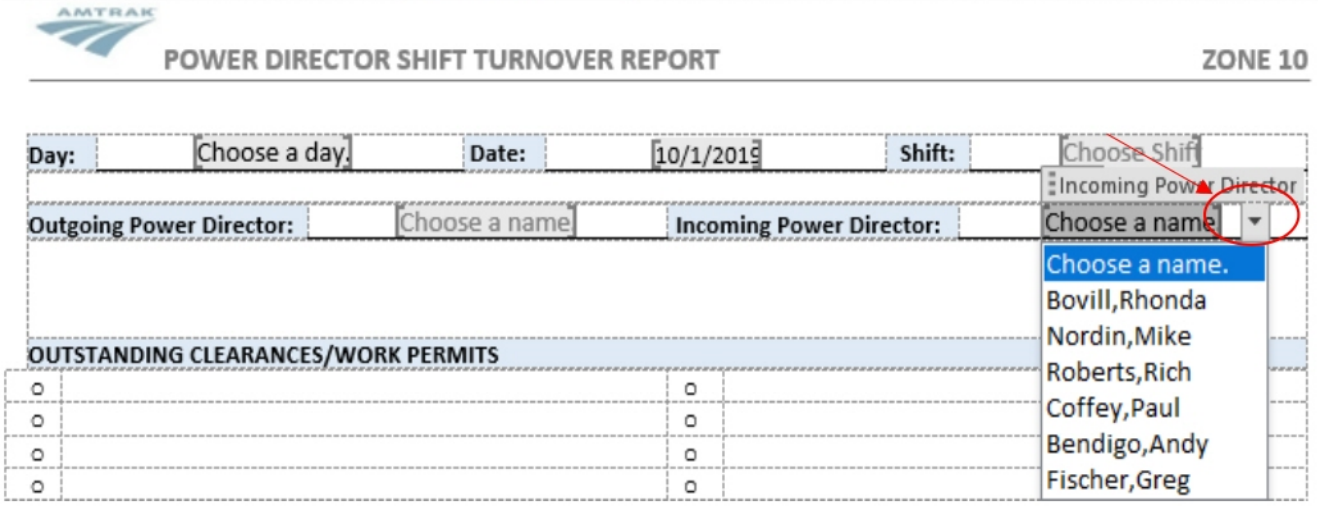
4. **Selects** "Shift" of report.



5. **Selects** names of following:

- Outgoing Power Director
- Incoming Power Director





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6. **Lists** all outstanding Clearances and Work Permits.

OUTSTANDING CLEARANCES/WORK PERMITS			
o	# 6080 8401 Trolley and Feeder	o	
o	# 6081 8601 Trolley Cove to Plains	o	
o	# 6082 7901 Trolley Sub 80 and Mill River	o	

7. **Describes** any current event in progress.
   - Include plate orders in effect not linked with a clearance.

CURRENT EVENTS IN PROGRESS			
o	Plate CVPL3 in Effect due to excessive ice	o	
o	Eversource at Sub 80 doing inspection	o	
o	Clearance #1700 in effect for Slot train	o	
o	No Comm. at 84A Elmwood Comm tech Notify	o	
o	Train 2151 reported arcing cat-pole 182-1	o	

8. **Notes** any changes in system configuration.

CHANGES IN SYSTEM CONFIGURATION			
o	Sub 86 BB closed for Nstar Work	o	
o	Sub 82 1L Open BB11 BB22 closed at W83	o	
o	T68 switch closed at Tower1	o	

9. **Adds** equipment removed from or returned to service within last 72 hours.

EQUIPMENT REMOVED FROM SERVICE LAST 72 HOURS			
o	13CB at Transfer	o	
o	22W at Lawn no DC	o	
o	11W Switch View bad control cable	o	

EQUIPMENT RETURNED TO SERVICE LAST 72 HOURS			
o	31CS Circuit Breaker Tower1	o	
o	80B01 Breaker at Madison	o	

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10. **Names** ET personnel on property.

ET PERSONNEL ON PROPERTY			
o	Bill Martin at Sub 86 due to no Comm.	o	
o	Linemen Scott Page , Jim Thackaberry till 8pm	o	

11. **Enters** upcoming major scheduled outages.

MAJOR SCHEDULED OUTAGES FOR NEXT SHIFT			
o	Double track outage Sharon East	o	
o	Sub 86 Eversource removing line 447-508 from service	o	
o	Metro North working phase breaks Mill River	o	

12. **Describes** any anticipated events.

UPCOMING EVENTS			
o	Sub 86 Eversource relocating line 447-508	o	
o		o	

13. **Adds** active ET letters.
    - Include relevant SOIs or memos.

ET LETTERS, MEMOS ISSUED LAST 72 HRS			
o	NED-E-ET FY109-19-11DBCS	o	
o	NED-E-FY07-001-UPDATE	o	
o	NED-E-ET-FY2019-12 COLLINWOOD	o	
o	NED-E-ET FY109-101 8401 FEEDER	o	

14. **Includes** general information relating to Operating Zone.
    - System outages or issues over last 72 hours can be included in this section.

GENERAL INFORMATION			
o	Sub 82 working On B side of RTU only	o	
o	A.C not working at 84B Providence	o	
o	Gate alarm not working at 83B Exeter	o	

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15. **Notes** impending inclement weather.

INCLEMENT WEATHER CONDITIONS			
o	High winds expected tonight in Boston	o	
o		o	

16. **Reviews** Shift Turnover report for accuracy.

17. **Sends** Email of Shift Turnover report to proper distribution list.

POWER DIRECTOR SHIFT TURNOVER REPORT **ZONE 10**

Day: Tuesday **Date:** 10/1/2019 **Shift:** 6:30am - 2:30pm

Outgoing Power Director: Bovill, Rhonda **Incoming Power Director:** Nordin,Mike

OUTSTANDING CLEARANCES/WORK PERMITS	
#6080 8401 trolley and Feeder	# 6082 7901 Trolley Sub 80 to Mill River
#6081 8601 TROLLEY Cove to Plains	
CURRENT EVENTS IN PROGRESS	
Plate CVPL3 in Effect due to excessive ice	No Comm. at 84A Elmwood Comm tech Notify
Eversource at Sub 80 doing inspection	Train 2151 reported arcing cat-pole 182-1
Clearance #1700 in effect for Slot train	
CHANGES IN SYSTEM CONFIGURATION	
Sub 86 BB closed for Nstar Work	T68 switch closed at Tower1
Sub 82 1L Open BB11 BB22 closed at W83	
EQUIPMENT REMOVED FROM SERVICE LAST 72 HOURS	
13CB at Transfer	11W Switch at View Bad control cable
22W Switch at Lawn	
EQUIPMENT RETURNED TO SERVICE LAST 72 HOURS	
31CS Circuit Breaker Tower1	80B01 Breaker at Madison
ET PERSONNEL ON PROPERTY	
Bill Martin at Sub 86 due to no Comm.	Linemen Scott Page , Jim Thackaberry till 8pm
MAJOR SCHEDULED OUTAGES FOR NEXT SHIFT	
Double track outage Sharon East	Metro North working phase breaks Mill River
Sub 86 Eversource removing line 447-508 from service	
UPCOMING EVENTS	
Sub 86 Eversource relocating line 447-508	
ET LETTERS, MEMOS ISSUED LAST 72 HRS	
NED-E-ET FY109-19-11DBCS	NED-E-ET-FY2019-12 COLLINWOOD
NED-E-FY07-001-UPDATE	NED-E-ET FY109-101 8401 FEEDER
GENERAL INFORMATION	
Sub 82 working On B side of RTU only	Gate alarm not working at 83B Exeter
A.C not working at 84B Providence	
INCLEMENT WEATHER CONDITIONS	
High winds expected tonight in Boston	

Figure STO 4-2. Completed Shift Turnover Report

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There are several Forms and Reports that the Power Director maintains and interprets daily. The ability to correctly maintain these documents is essential to proper system operation and documentation. The maintenance of most of the forms and reports covered in this section are integral steps in many of the other tasks described in this manual. The tasks included in this section are:

FAR-1 **Maintaining** Power Director Log Book.
FAR-2 **Requesting** Vacation.
FAR-3 **Maintaining** Out of Service Equipment Log.
FAR-4 **Maintaining** Clearance Form NEC.84.

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FAR-1 MAINTAINING POWER DIRECTOR LOG BOOK

1.0 INTRODUCTION

The Power Director on duty is responsible to identify, report and document all system disturbances and occurrences on the Amtrak electrification system. This includes routine actions, such as mark-offs, call-outs, equipment that was returned to service etc. as well as unusual actions and events, such as trippings, unscheduled power outages, equipment or computer failure, injuries etc., actions that were taken and who was notified.

Each operating zone has its own Log Book. The Power Director's Log Book is the main tool used to document such events, it is therefore important that this log be maintained properly. Proper log entries ensure that past events can be easily researched.

All system disturbances and occurrences must be recorded and analyzed to ensure the interconnected system responded appropriately to ensure the continuous reliability of Amtrak's electrification system.

2.0 TASK OBJECTIVE

Enter all appropriate data into the Power Director Log Book to ensure a complete and accurate record is maintained of any and all system disturbances or occurrences within the operating zone.

3.0 RECOMMENDED CONDITIONS

This task shall be performed as soon as possible after a system disturbance or occurrence takes place to ensure all of the details of the event can be accurately recalled and recorded.

4.0 REFERENCES

- Log Book
- SCADA Operating System
- Appendix A. Glossary
- Appendix B. Abbreviations & Acronyms

5.0 POWER DIRECTOR ACTION

To log a system disturbance or occurrence, the **Power Director:**

1. **Opens** Log Book.
2. **Enters** date of event.
3. **Records** time of event.
4. **Identifies** event.
5. **Describes** event.

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6. **Provides** following information for event:
   - Locations
   - Alarms received
   - Times and correct sequence of equipment that tripped
   - Action taken
   - Times equipment was re-closed
   - AC holds in place
   - Equipment left out of service
   - Relay targets
   - Weather conditions at time of event
   - Who was notified
   - Cause. Do not surmise or guess
   - Root cause (factor that caused event)

7. If follow up information for event becomes available after log entry is finalized:

   7a. **Enters** additional information that was provided.

ATTENTION

Abbreviations & Acronyms and may be used to make the logging process easier.
Refer to Appendix B. for typical Abbreviations & Acronyms.

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FAR-2 REQUESTING VACATION

1.0 INTRODUCTION

The Boston Power Director Office is a 24-hour 7 days a week operation. The office is staffed by one or two Power Directors per shift except when system emergencies occur or inclement weather is projected. It is therefore important that the office not be put at risk left understaffed if such a condition should arise.

Power Directors requesting vacation or personal days must apply, in writing, to the immediate supervisor 48 hours advance notice is required and no exceptions will be made. Only one Power Director will be granted off at a time.

A week's vacation will take precedence over a single day(s) request and no time will be reserved for future requests. Future changes will be considered only if the changes are made on an exchange basis, i.e. an existing day must be canceled in order for the requested day to be granted. Request for cancellation of vacation or personal day must be in writing to the immediate supervisor no later than 24 hours in advance for consideration by the Corporation.

The vacation request calendar, as shown in Figure FAR 2-1, must be submitted to the immediate supervisor by January 31 of that calendar year. All eligible vacation time must be requested. Failure to do so will result in assignment by the corporation. There will be no reminders. All vacation request, prior to January 31 of that year, will begin on December 1st and end at the close of business on December 17th of the previous year. Any vacation requests after the December 17th deadline will be handled on a first request basis regardless of seniority for the month of January.

All personal day requests, regardless of the date, must be received to the immediate supervisor prior to August 31 of that calendar year. Failure to do so will result in assignment by the Corporation.
Figure FAR 2-2 shows vacation entitlements.

2.0 TASK OBJECTIVE

Submit vacation or personal day requests by entering all appropriate information into the vacation request calendar and submit to immediate supervisor.

3.0 RECOMMENDED CONDITIONS

This task should be performed when requesting vacation or personal day.

4.0 REFERENCES

- BOSPD Vacation Calendar.xls
- Appendix B. Abbreviations & Acronyms

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5.0 POWER DIRECTOR ACTION

To request vacation or personal day, the **Power Director:**

1. **Opens** Vacation Calendar.xls

POWER DIRECTOR VACATION CALENDAR 2019

January						
Su	M	Tu	W	Th	F	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

February						
Su	M	Tu	W	Th	F	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28		

March						
Su	M	Tu	W	Th	F	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

April						
Su	M	Tu	W	Th	F	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

May						
Su	M	Tu	W	Th	F	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

June						
Su	M	Tu	W	Th	F	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

July						
Su	M	Tu	W	Th	F	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

August						
Su	M	Tu	W	Th	F	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

September						
Su	M	Tu	W	Th	F	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

October						
Su	M	Tu	W	Th	F	Sa
	1	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

November						
Su	M	Tu	W	Th	F	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

December						
Su	M	Tu	W	Th	F	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Notes

Figure FAR 2-1. Power Director Vacation Calendar

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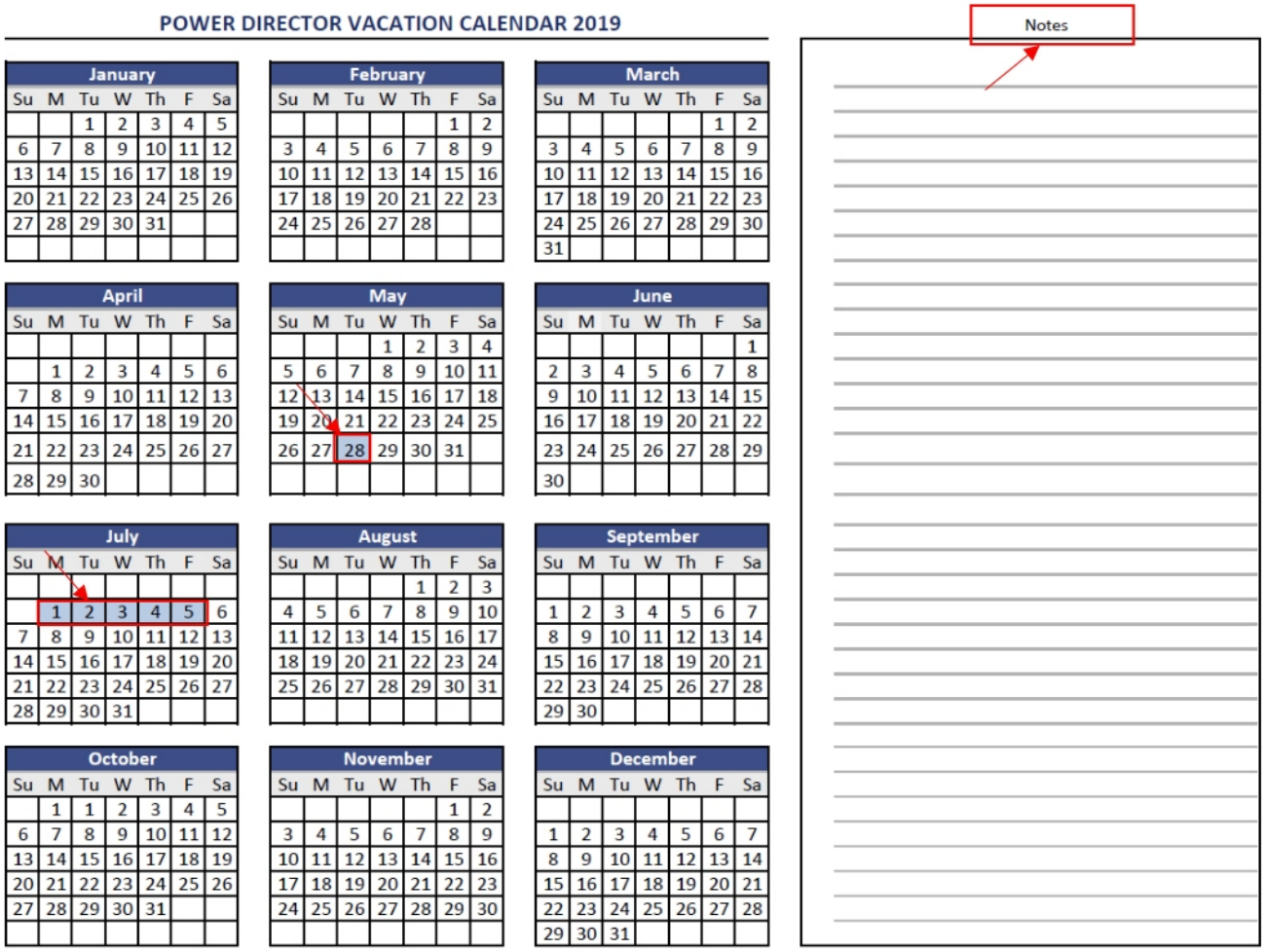
2. **Shades** in all entitled vacation days.
   - No specific color required to fill in days.
3. If comments are needed regarding request.

   3a. **Enters** remarks under "Notes" section of sheet.



4. **Sends** vacation request to immediate Supervisor.

Requirements	Vacation Weeks	Plus
120 compensated days in 2018.	2	
100 compensated days in each of eight (8) years completed service (Hired 7/15/2011).	3	One (1) personal leave day.
100 compensated days in each of seventeen (17) years completed service (Hired 7/15/2002).	4	Two (2) personal leave days.
100 compensated days in each of twenty-five (25) years completed service (Hired 7/15/94).	5	Two (2) personal leave days.

Figure FAR 2-2. Vacation Entitlement

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FAR-3 MAINTAINING OUT OF SERVICE EQUIPMENT LOG

1.0 INTRODUCTION

Each Power Director operating zone maintains an Out-of-Service Equipment Log. The purpose of this log is to maintain an up-to-date list of all equipment on the Amtrak Electric Traction electrification system that is not available for service, whatever the cause.

When equipment is removed from service, the Power Director selects the appropriate tab and enters the date, location, equipment type, the reason for the equipment to be left out of service.

When the equipment is returned to service, that date is also entered as well as any repairs that were made. Properly maintaining this log allows for efficient shift turnovers, ensuring the history and details of equipment can be easily researched and information accurately recalled.

2.0 TASK OBJECTIVE

Enter all appropriate information into the Out-of-Service Equipment log to ensure a complete and accurate record is maintained of all system equipment removed from or returned to service.

3.0 RECOMMENDED CONDITIONS

This task should be performed as soon as possible after becoming aware of a piece of system equipment has been removed from or returned to service.

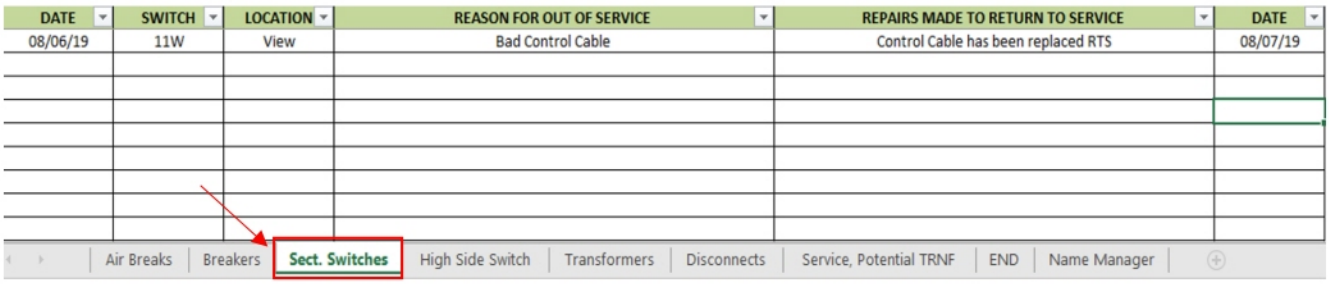
4.0 REFERENCES

- Out of Service Equipment.xls
- Microsoft Outlook Mail
- SCADA Operating System
- Appendix A. Glossary
- Appendix B. Abbreviations & Acronyms

5.0 POWER DIRECTOR ACTION

To enter information into the “Out of Service Equipment Log”, the **Power Director:**

1. **Opens** Out of Service Equipment.xls for appropriate operating zone.
2. **Selects** equipment type tab at bottom of sheet.



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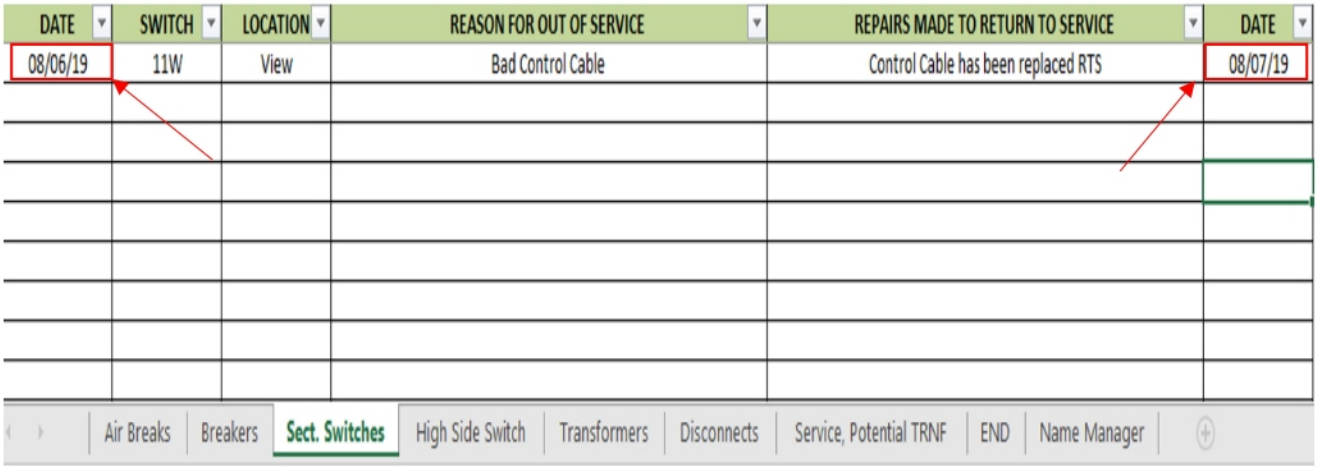
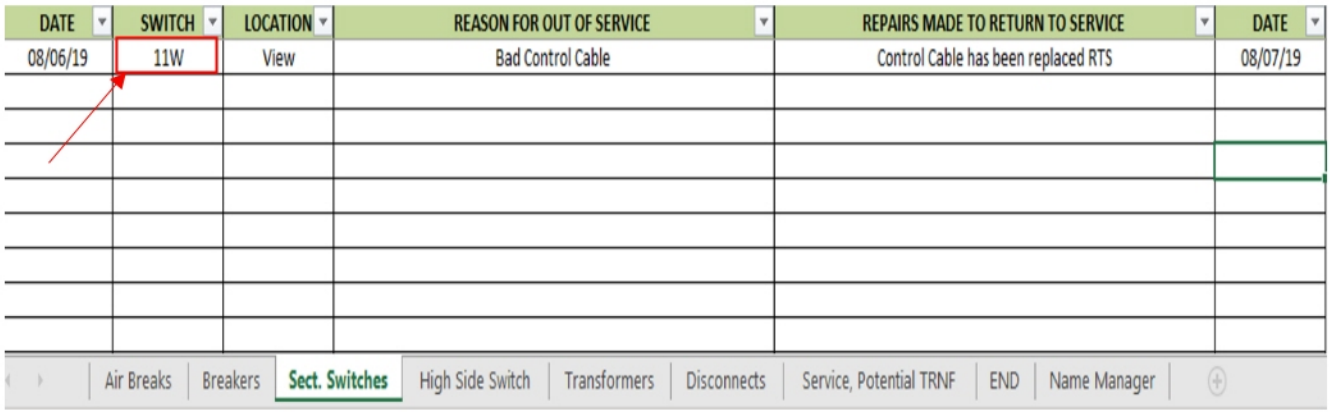
3. **Enters** date equipment removed from or returned to service.



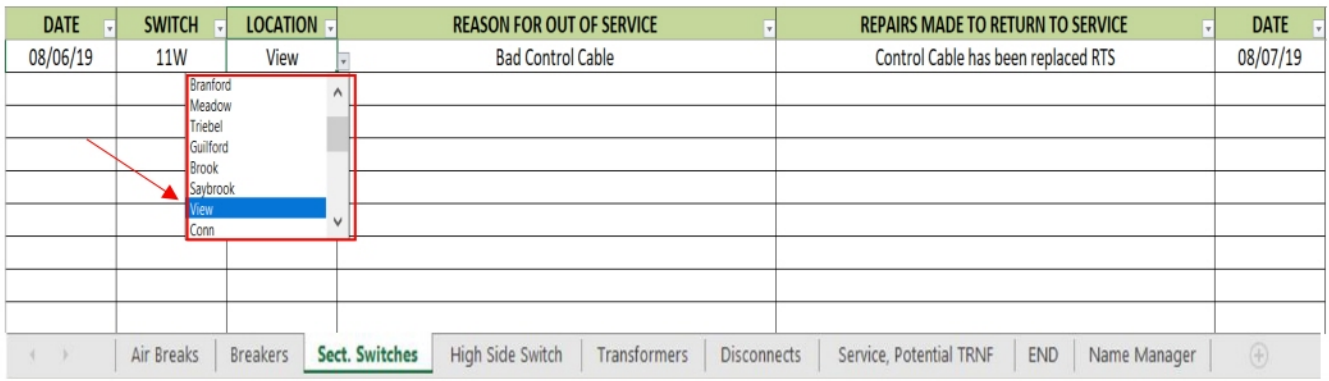
4. **Enters** equipment designation.



ATTENTION

Multiple circuits or apparatus must be recorded separately when they are placed OOS.

5. **Selects** location of equipment.



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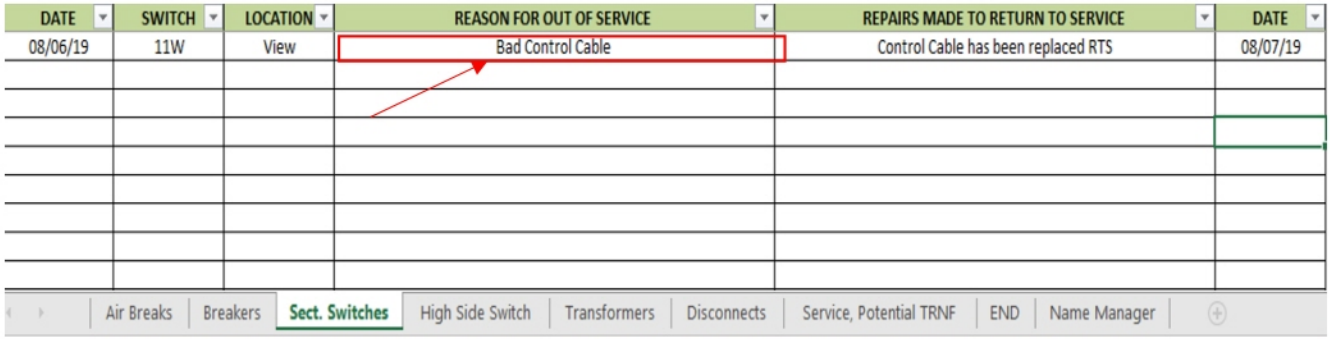
6. If equipment was removed from service:

   6a. **Enters** reason equipment was removed.

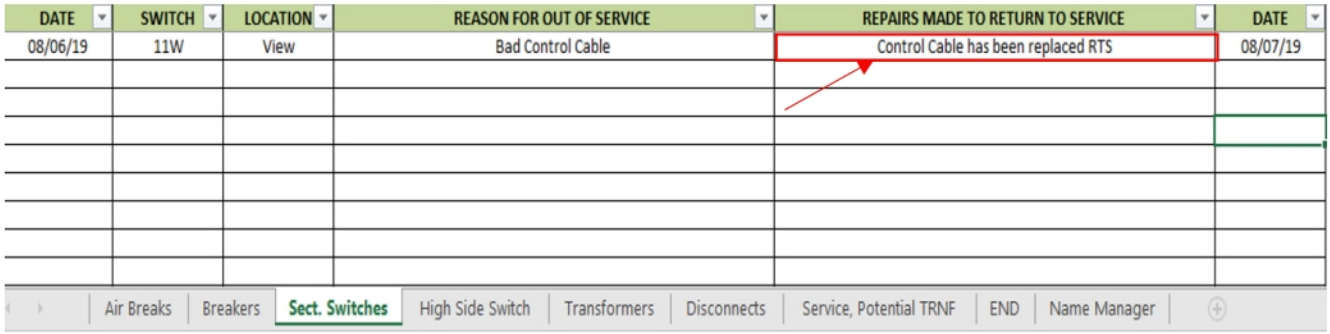


DATE	SWITCH	LOCATION	REASON FOR OUT OF SERVICE	REPAIRS MADE TO RETURN TO SERVICE	DATE
08/06/19	11W	View	Bad Control Cable	Control Cable has been replaced RTS	08/07/19

Air Breaks | Breakers | Sect. Switches | High Side Switch | Transformers | Disconnects | Service, Potential TRNF | END | Name Manager

7. If equipment was returned to service:

   7a. **Enters** repairs that were made.



DATE	SWITCH	LOCATION	REASON FOR OUT OF SERVICE	REPAIRS MADE TO RETURN TO SERVICE	DATE
08/06/19	11W	View	Bad Control Cable	Control Cable has been replaced RTS	08/07/19

Air Breaks | Breakers | Sect. Switches | High Side Switch | Transformers | Disconnects | Service, Potential TRNF | END | Name Manager

ATTENTION

The OOS Log must be updated when additional information is made available.

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FAR-4 MAINTAINING CLEARANCE FORM NEC.84

1.0 INTRODUCTION

The Clearance Form (NEC.84) is a legal document from the Power Director to Class "A" employee declaring that the equipment to be worked on has been de-energized and isolated from hazardous sources of energy as governed by minimum approach distances.

The Clearance Form is used to record the description of the clearance, referred to as the body of the clearance. In addition, all permissions and/or notifications are listed as well as all switching, and actions performed under the direction of the Power Director. The limits of a clearance are the blocking points established by the switching procedures to de-energize (dangerous to life) an area as defined by the body of the clearance, that is an understanding between the Power Director and the Class "A" employee. The clearance number is a specific, identifying number assigned to a clearance. It is imperative that each Power Director fill out the Clearance Form in an exact manner so that, after Shift Turnover, the incoming Power Director can look at the clearance and determine the status of the clearance.

Figure FAR 4-1 shows the front of the Clearance Form (NEC.84) which includes the clearance request, permissions or notifications pertaining to the clearance, switching record, testing clearance requested de-energized, issuing and releasing of the clearance. Figure FAR 4-9 shows the back of the Clearance Form (NEC.84) which includes releasing the clearance temporary, re-issuing the clearance, transferring of the clearance between two Class "A" employees or a clearance transfer between a Class "A" employee and the Power Director Office.

2.0 TASK OBJECTIVE

Record all appropriate information, in a neat and legible manner, on the Clearance Form (NEC.84) to ensure a complete and accurate record is maintained of all permissions, device operations, switching orders and system grounds (if applicable) pertaining to the clearance.

3.0 RECOMMENDED CONDITIONS

This task should be performed during the performance of any of the following:

- Requesting a clearance
- Permissions or notifications pertaining to clearance
- Switching instructions to de-energize or re-energize circuits or apparatus
- Testing circuits or apparatus de-energized
- Issuing and releasing clearance
- Releasing clearance temporary/ re-issue clearance
- Transferring a clearance between Class "A" employees
- Transferring a clearance to/ from the Power Director Office

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4.0 REFERENCES

- Power Director Clearance Form (NEC.84)
- SCADA Operating System
- Contact List
- Power Sectionalizing Plate Reference Book
- AMT.2 Electrical Operating Rules & Instructions
- SOI.203 Voltage Testing and Verification Procedure
- SOI.211 Electrical Clearance Procedure
- Appendix A. Glossary
- Appendix B. Abbreviations & Acronyms

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Electric Traction Power Director Clearance Form

Clearance No: 1 Day: 2 Date: 3 Time Requested: 4 ☐ AM ☐ PM

Power must be removed from: 5 On account of: 6 Location: 7

Remarks: 8

Train Dispatcher/ Others

9 Plate: 10 Notified: 11 ☐ AM ☐ PM Permission: 12 ☐ AM ☐ PM
Plate: Notified: ☐ AM ☐ PM Permission: ☐ AM ☐ PM
Plate: Notified: ☐ AM ☐ PM Permission: ☐ AM ☐ PM
Plate: Notified: ☐ AM ☐ PM Permission: ☐ AM ☐ PM

13 Signal Interruption Notified: 14 ☐ AM ☐ PM Permission: 15 ☐ AM ☐ PM Completed: 16 ☐ AM ☐ PM

Load Dispatcher: 17 Permit No. 18 Notified: 19 ☐ AM ☐ PM Permission: 20 ☐ AM ☐ PM In Effect: 21 ☐ AM ☐ PM

Location	Device			Opened		Tagged		Tag Removed		Closed	
	Switch	Breaker	Air Break	Time:	Date:	Time:	Date:	Time:	Date:	Time:	Date:
22	23	24	25	26		27		28		29	

138 kV ground switch checked closed by: 30 Location: 31 at: 32 ☐ AM ☐ PM

33 Employee Permission to test (circuit/apparatus) de-energized at: 34 ☐ AM ☐ PM

tested (circuit/apparatus) de-energized at: 35 ☐ AM ☐ PM

Clearance No: 36 Day: 37 Date: 38 To: 39

Power has been removed from the following circuit/apparatus:

40

Permission to ground above circuit/apparatus: Time effective: 41 ☐ AM ☐ PM Clearance repeated correctly at: 42 ☐ AM ☐ PM

No. of Grounds applied: 43 Power Director: 44 Clearance Issued (Print/ Sign)

Location of Grounds: 45

No. of Grounds removed: 46

Clearance No: 47 Day: 48 Date: 49 Employee: 50

Reports work completed, all personnel clear, grounds 51 ☐ Removed ☐ NOT Removed from following circuit/apparatus: 52 (*read body of clearance*)

53 ☐ OK ☐ NOT OK to energize at: 54 ☐ AM ☐ PM 55 ☐ Energized ☐ NOT Energized at: 56 ☐ AM ☐ PM

Train Dispatcher/ Others

57 Plate: 58 Notified: 59 ☐ AM ☐ PM Released: 60 ☐ AM ☐ PM
Plate: Notified: ☐ AM ☐ PM Released: ☐ AM ☐ PM
Plate: Notified: ☐ AM ☐ PM Released: ☐ AM ☐ PM
Plate: Notified: ☐ AM ☐ PM Released: ☐ AM ☐ PM

61 Signal Interruption Notified: 62 ☐ AM ☐ PM Permission: 63 ☐ AM ☐ PM Completed: 64 ☐ AM ☐ PM

Load Dispatcher: 65 Permit No. 66 Notified: 67 ☐ AM ☐ PM Released: 68 ☐ AM ☐ PM Completed: 69 ☐ AM ☐ PM

Power Director: 70 Clearance Completed (Print/ Sign)

Figure FAR 4-1. Front of Blank Clearance Form NEC.84

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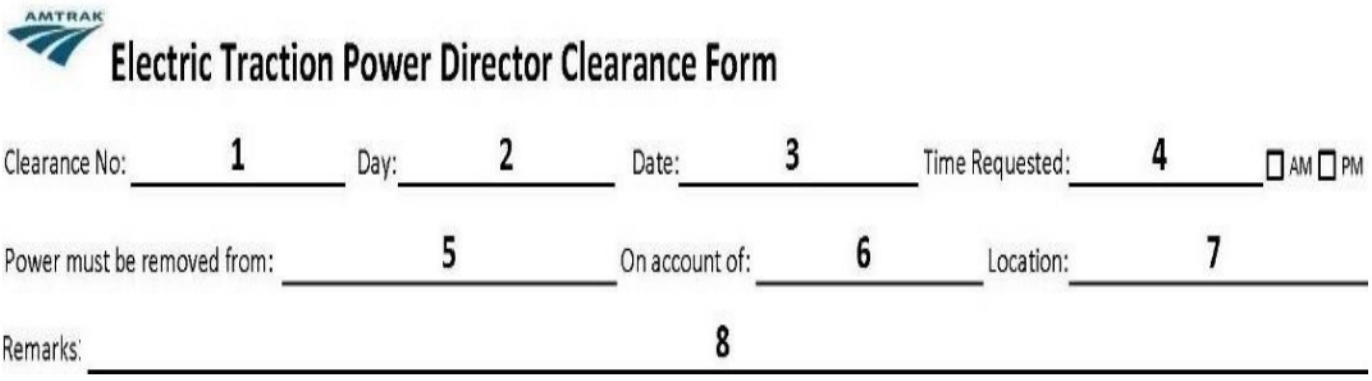
5.0 POWER DIRECTOR ACTION

To enter information on Clearance Form (NEC.84), the **Power Director:**


Electric Traction Power Director Clearance Form

Clearance No: 1 Day: 2 Date: 3 Time Requested: 4 ☐ AM ☐ PM

Power must be removed from: 5 On account of: 6 Location: 7

Remarks: 8

Figure FAR 4-2. Clearance Request Section of Clearance Form NEC.84

Refer to "clearance request section" of NEC.84 form, which consists of spaces 1-8 in Figure FAR 4-2 above.

1. **Enters** "clearance number".
2. **Writes** "day" clearance was requested.
3. **Writes** "date" clearance was requested.
4. **Adds** "time" clearance was requested. Adds check mark for AM or PM.
   - Entries on lines 2, 3 and 4 are when Class "A" employee makes official clearance request.
5. **Identifies** circuit or apparatus where "power must be removed from" such as:
   - 8402 Trolley and Feeder
   - 83B02 Breaker
   - TA02/TA01 Service XFMR
   - 8301TF Disconnect switch
   - #2 XFMR
6. **Provides** reason for removal of power such as:
   - Maintenance
   - Repair
   - Replacement
   - Protection
   - Catenary inspection
   - Doble test
7. **Enters** "location" where work will be performed such as:
   - Sub 84 Warwick
   - Kingston interlocking
   - 83B Exeter
   - RT146 OHB
   - RT128 Train Station
   - East Haven Tunnels
8. **Provides** "remarks" pertaining to clearance such as:
   - Clear time
   - Contact numbers
   - Supervisor/ Foreman on location
   - Clearance numbers sharing same blocking

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Train Dispatcher/ Others

9 Plate: 10 Notified: 11 ☐ AM ☐ PM Permission: 12 ☐ AM ☐ PM
Plate: Notified: ☐ AM ☐ PM Permission: ☐ AM ☐ PM
Plate: Notified: ☐ AM ☐ PM Permission: ☐ AM ☐ PM
Plate: Notified: ☐ AM ☐ PM Permission: ☐ AM ☐ PM

13 Signal Interruption Notified: 14 ☐ AM ☐ PM Permission: 15 ☐ AM ☐ PM Completed: 16 ☐ AM ☐ PM

Load Dispatcher: 17 Permit No. 18 Notified: 19 ☐ AM ☐ PM Permission: 20 ☐ AM ☐ PM In Effect: 21 ☐ AM ☐ PM

Figure FAR 4-3. Clearance Permissions Section of Clearance Form NEC.84

Refer to "clearance permissions section" of NEC.84 form, which consists of spaces 9-21 in Figure FAR 4-3 above.

9. **Provides** "names and/or title of people" required to provide permissions for clearance such as:
   - Train Dispatchers
   - Power Directors
   - Foreign Railroad Power Dispatchers
   - Utility Operators
10. **Records** power sectionalizing "plate" name and number as required by plate reference book.
11. **Enters** time people named in No.09 above were "notified". Adds check mark for AM or PM.
12. **Enters** time "permission received" for authorization request from individuals named in No.09 above. Adds check mark for AM or PM.
13. **Provides** "names and/or title" of people required to give permission prior to taking a signal interruption.
14. **Enters** time individuals named in No.13 above were "notified" of signal interruption request. Adds check mark for AM or PM.
15. **Enters** time "permission received" for signal interruption from individuals named in No.13. Adds check mark for AM or PM.
16. **Notes** time signal interruption was "completed". Adds check mark for AM or PM.
17. **Adds** "name" of Load Dispatcher.
18. **Enters** "permit number" that was supplied.
19. **Enters** time Load Dispatcher was "notified" of permit request. Adds check mark for AM or PM.
20. **Enters** time "permission received" from Load Dispatcher to de-energize circuit or apparatus. Adds check mark for AM or PM.
21. **Records** time permit was put "in effect". Adds check mark for AM or PM.
    - When primary circuit or apparatus is de-energized
    - 138 kV ground switch is closed for transmission line clearances

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Location	Device			Opened		Tagged		Tag Removed		Closed	
	Switch	Breaker	Air Break	Time:	Date:	Time:	Date:	Time:	Date:	Time:	Date:
22	23	24	25	26		27		28		29	

Figure FAR 4-4. Switching and Tagging of Devices Section of Clearance Form NEC.84

Refer to "switching/tagging of devices section" of NEC.84 form, which consists of spaces 22-29 in Figure FAR 4-4 above.

22. **Adds** "location" of devices to be operated as identified in columns 23, 24 and 25 such as:
    - 80C Grove Beach
    - Substations: Sub 86 Sharon
    - Yards: South Hampton Street
    - Interlockings: Lawn

23. **Enters** specific name of "switch" to be operated such as:
    - Trolley breaker disconnect switches: 8402 T&F
    - Low side breaker disconnects: 1LBs, 2LBs
    - Sect. switches: 22W, 22E
    - VT and Service XFMR switches: TA01F Fuse disconnect
    - "TCYT" disconnects
    - 84TB Disconnect

24. **Enters** specific name of circuit "breaker" to be operated such as:
    - Trolley breakers: 8402, 83A02
    - High side circuit breakers: 11, 22
    - Feeder breakers: TCY
    - Low side breakers: 1L, 2L
    - Bus/ Bus Tie breakers: BB, BB11, BB22

25. **Enters** specific name of "air break" switch to be operated such as:
    - Transmission tie switches: 12
    - Transmission line/ ground switches: G700, G701
    - High side switches: 11H, 22H

26. **Records** time/date device listed was "opened" or checked open.

27. **Records** time/date "tag applied" to device listed.
    - Paper: Do Not Operate red tag (NEC-105)
    - Electronic: SCADA

28. **Records** time/date "tag removed" from device listed.

29. **Records** time/date that device listed was "closed".
    - If device is left open, enters "*open*" in space.

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ATTENTION

The Switching/Tagging of Devices Section of Form can also be used to track additional information

Location	Device			Opened		Tagged		Tag Removed		Closed	
	Switch	Breaker	Air Break	Time:	Date:	Time:	Date:	Time:	Date:	Time:	Date:
Sub 10 Warwick	DC removed from 11TF disconnect at _____ Restored at _____										
"	Place the auto transfer switch into manual mode at _____Restored to auto at _____										
84A Elmwood	Primary fuse removed from TA01 service transformers at _____ Restored at _____										

138 kV ground switch checked closed by: 30 Location: 31 at: 32 ☐ AM ☐ PM

33
Employee

Permission to test (circuit/apparatus) de-energized at: 34 ☐ AM ☐ PM

tested (circuit/apparatus) de-energized at: 35 ☐ AM ☐ PM

Figure FAR 4-5. Testing Circuit/Apparatus De-Energized Section of Clearance Form NEC.84

Refer to "testing circuit/apparatus de-energized section" of NEC.84 form, which consists of spaces 30-35 in Figure FAR 4-5 above.

30. **Enters** "name" of Class "A" employee reporting (138 kV) ground switch visually checked closed in field.
31. **Adds** "location(s)" where (138 kV) ground switch was visually checked closed.
32. **Records** "time" (138 kV) ground switch was visually checked closed. Adds check mark for AM or PM.
33. **Enters** "name" of Class "A" employee testing circuit/apparatus de-energized.
34. **Records** time Class "A" employee given "permission to test circuit/apparatus de-energized". Adds check mark for AM or PM.
35. **Records** time Class "A" employee "reporting circuit/apparatus tested de-energized". Adds check mark for AM or PM.

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Clearance No: 36 Day: 37 Date: 38 To: 39

Power has been removed from the following circuit/apparatus:

40

Permission to ground above circuit/apparatus: Time effective: 41 ☐ AM ☐ PM Clearance repeated correctly at: 42 ☐ AM ☐ PM

No. of Grounds applied: 43 **Power Director:** 44

Clearance Issued (Print/ Sign)

Location of Grounds: 45

Figure FAR 4-6. Issuing a Clearance Section of Clearance Form NEC.84

Refer to "issuing a clearance section" of NEC.84 form, which consists of spaces 36-45 in Figure FAR 4-6 above.

36. **Enters** "clearance number".
37. **Enters** "day" clearance is being issued.
38. **Enters** "date" clearance is being issued.
39. **Enters** "name" of Class "A" employee receiving clearance.
40. **Writes** circuit/apparatus where "power has been removed". DO NOT use abbreviations.
    - referred to as body of clearance being issued
41. **Enters** time clearance was made "effective". Adds check mark for AM or PM.
42. **Enters** time clearance body and effective time "repeated correctly" by Class "A" employee. Adds check mark for AM or PM.
43. **Records** "number of grounds applied" to circuit/apparatus as reported by Class "A" employee.
44. **Prints** and **signs** name after "clearance issued" to Class "A" employee.
45. **Records** "locations where grounds applied" to circuit/apparatus as reported by Class "A" employee.

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No. of Grounds removed: 46

Clearance No: 47 Day: 48 Date: 49 Employee: 50

Reports work completed, all personnel clear, grounds 51 ☐ Removed ☐ NOT Removed from following circuit/apparatus: 52 *(read body of clearance)*

53 ☐ OK ☐ NOT OK to energize at: 54 ☐ AM ☐ PM 55 ☐ Energized ☐ NOT Energized at: 56 ☐ AM ☐ PM

Figure FAR 4-7. Releasing a Clearance Section of Clearance Form NEC.84

Refer to "releasing a clearance section" of NEC.84 form, which consists of spaces 46-56 in Figure FAR 4-7 above.

46. **Records** "number and location of grounds" that were removed from circuit/apparatus as reported by Class "A" employee.
47. **Enters** "clearance number".
48. **Enters** "day" clearance is being released.
49. **Enters** "date" clearance is being released.
50. **Enters** "name" of Class "A" employee releasing clearance.
51. **Places** check mark to show condition of temporary protective grounds. "removed or not removed"
52. **Reads** circuit/apparatus as stated in No.40 above. "body of clearance" being released
53. **Places** check mark to state if circuit/apparatus is "OK or NOT OK" to energize.
54. **Enters** time circuit/apparatus is "OK or NOT OK" to energize. Adds check mark for AM or PM.
55 **Places** check mark to show condition of circuit/apparatus. "energized or NOT energized"
56. **Enters** time circuit/apparatus was "energized or NOT energized". Adds check mark for AM or PM.

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Train Dispatcher/ Others

57 Plate: 58 Notified: 59 ☐ AM ☐ PM Released: 60 ☐ AM ☐ PM

Plate: Notified: ☐ AM ☐ PM Released: ☐ AM ☐ PM

Plate: Notified: ☐ AM ☐ PM Released: ☐ AM ☐ PM

Plate: Notified: ☐ AM ☐ PM Released: ☐ AM ☐ PM

61 Signal Interruption Notified: 62 ☐ AM ☐ PM Permission: 63 ☐ AM ☐ PM Completed: 64 ☐ AM ☐ PM

Load Dispatcher: 65 Permit No. 66 Notified: 67 ☐ AM ☐ PM Released: 68 ☐ AM ☐ PM Completed: 69 ☐ AM ☐ PM

Power Director: 70
Clearance Completed (Print/ Sign)

Figure FAR 4-8. Clearance Permissions Section of Clearance Form NEC.84

Refer to "clearance permissions section" of NEC.84 form, which consists of spaces 51-70 in Figure FAR 4-8 above.

57. **Provides** "names and/or title of people" notified of clearance release such as:
    - Train Dispatchers
    - Power Directors
    - Foreign Railroad Power Dispatchers
    - Utility Operators
58. **Records** power sectionalizing "plate" name and number to be released.
59. **Enters** time people named in No.57 above were "notified". Adds check mark for AM or PM.
60. **Enters** time plate was "released". Adds check mark for AM or PM.
61. **Provides** "names and/or title" of people required to give permission prior to taking a signal interruption.
62. **Enters** time individuals named in No.61 above were "notified" of signal interruption request. Adds check mark for AM or PM.
63. **Enters** time "permission received" for signal interruption from individuals named in No.61. Adds check mark for AM or PM.
64. **Notes** time "signal interruption" was completed. Adds check mark for AM or PM.
65. **Adds** "name" of Load Dispatcher.
66. **Enters** "permit number".
67. **Enters** time Load Dispatcher was "notified" of permit release. Adds check mark for AM or PM.
68. **Enters** time "permission received" from Load Dispatcher to re-energize circuit or apparatus. Adds check mark for AM or PM.
69. **Records** time permit was "completed". Adds check mark for AM or PM.
70. **Prints** and **signs** name after "clearance completed".

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Temporary Clearance Release

No. of Grounds removed: 1

Clearance No: 2 Day: 3 Date: 4 Employee: 5

Reports all personnel clear, grounds removed from following circuit/apparatus:

6

OK to energize temporary at: 7 ☐ AM ☐ PM Energized at: 8 ☐ AM ☐ PM

Location	Device Closed	Time	Train Dispatcher/ Others	Plate(s)	Released Time
9	10	11	12	13	14

Power Director: 15
Clearance Released (Print/ Sign)

Clearance Reissue

Train Dispatcher/ Others	Plate(s)	Time Notified	Permission Time	Location	Device Opened	Time
16	17	18	19	20	21	22

23
Employee

Permission to test (circuit/apparatus) de-energized at: 24 ☐ AM ☐ PM

tested (circuit/apparatus) de-energized at: 25 ☐ AM ☐ PM

Clearance No: 26 Day: 27 Date: 28 To: 29

Power has been removed from the following circuit/apparatus: 30 *(read body of clearance)*

Permission to ground above circuit/apparatus: Time effective: 31 ☐ AM ☐ PM Clearance repeated correctly at: 32 ☐ AM ☐ PM

No. of Grounds applied: 33 Power Director: 34
Clearance Reissued (Print/ Sign)

Location of Grounds: 35

Transfer of Clearance No. 36

Circuit/apparatus:

37

Employee/ Power Director Office	Time	Date	Power Director	No. of Grounds	Ground Locations
38	39	40	41	42	43

Figure FAR 4-9. Back of Blank Clearance Form NEC.84

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Temporary Clearance Release

No. of Grounds removed: 1

Clearance No: 2 Day: 3 Date: 4 Employee: 5

Reports all personnel clear, grounds removed from following circuit/apparatus:

6

OK to energize temporary at: 7 ☐ AM ☐ PM Energized at: 8 ☐ AM ☐ PM

Location	Device Closed	Time	Train Dispatcher/ Others	Plate(s)	Released Time
9	10	11	12	13	14

Power Director: 15
Clearance Released (Print/ Sign)

Figure FAR 4-10. Temporary Clearance Release Section of Clearance Form NEC.84

Refer to "temporary clearance release section" of NEC.84 form, which consists of spaces 1-15 in Figure FAR 4-10 above.

1. **Records** "number and location of grounds" that were removed from circuit/apparatus as reported by Class "A" employee.
2. **Enters** "clearance number".
3. **Enters** "day" clearance is being released temporary.
4. **Enters** "date" clearance is being released temporary.
5. **Enters** "name" of Class "A" employee releasing clearance temporary.
6. **Writes** circuit/apparatus as stated in step No.40. DO NOT use abbreviations.
   - referred to as body of clearance being released temporary
7. **Enters** time circuit/apparatus is OK to "energize temporary". Adds check mark for AM or PM.
8. **Enters** time circuit/apparatus was "energized". Adds check mark for AM or PM.
9. **Adds** "location" of device to be closed.
10. **Enters** specific name of "device" to be closed.
11. **Enters** "time" tag removed from device and closed. Includes AM or PM as part of time.
12. **Provides** "names and/or title of people" required to be notified.
13. **Records** power sectionalizing "plate" name and number to be released.
14. **Enters** time plate was "released". Includes AM or PM as part of time.
15. **Prints** and **signs** name after "clearance released".

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Clearance Reissue

Train Dispatcher/ Others	Plate(s)	Time Notified	Permission Time	Location	Device Opened	Time
16	17	18	19	20	21	22

23
Employee

Permission to test (circuit/apparatus) de-energized at: 24 ☐ AM ☐ PM

tested (circuit/apparatus) de-energized at: 25 ☐ AM ☐ PM

Clearance No: 26 Day: 27 Date: 28 To: 29

Power has been removed from the following circuit/apparatus: 30 *(read body of clearance)*

Permission to ground above circuit/apparatus: Time effective: 31 ☐ AM ☐ PM Clearance repeated correctly at: 32 ☐ AM ☐ PM

No. of Grounds applied: 33 Power Director: 34
Clearance Reissued (Print/ Sign)

Location of Grounds: 35

Figure FAR 4-11. Clearance Reissue Section of Clearance Form NEC.84

Refer to "clearance reissue section" of NEC.84 form, which consists of spaces 16-35 in Figure FAR 4-11 above.

16. **Provides** "names and/or title of people" required to provide permissions for clearance.
17. **Records** power sectionalizing "plate" name and number as required by plate reference book.
18. **Enters** time people named in No.16 above were "notified". Includes AM or PM as part of time.
19. **Enters** time "permission received" for clearance authorization request from individuals named in No.16 above. Includes AM or PM as part of time.
20. **Adds** "location" of device to be opened.
21. **Enters** specific name of device to be "opened and tag applied".
22. **Enters** "time" device was opened and tag applied. Includes AM or PM as part of time.
23. **Enters** "name" of Class "A" employee testing circuit/apparatus de-energized.
24. **Records** time Class "A" employee given "permission to test circuit/apparatus de-energized". Adds check mark for AM or PM.
25. **Records** time Class "A" employee "reporting circuit/apparatus tested de-energized". Adds check mark for AM or PM.
26. **Enters** "clearance number".
27. **Enters** "day" clearance is being reissued.
28. **Enters** "date" clearance is being reissued.
29. **Enters** "name" of Class "A" employee receiving clearance.
30. **Reads** circuit/apparatus as stated in No.06 above. "body of clearance" being reissued

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31. **Enters** time clearance was made "effective". Adds check mark for AM or PM.
32. **Enters** time clearance body and effective time "repeated correctly" by Class "A" employee. Adds check mark for AM or PM.
33. **Records** "number of grounds applied" to circuit/apparatus as reported by Class "A" employee.
34. **Prints** and **signs** name after "clearance reissued" to Class "A" employee.
35. **Records** "location where grounds applied" to circuit/apparatus as reported by Class "A" employee.

Transfer of Clearance No. 36

Circuit/apparatus:

37

Employee/ Power Director Office	Time	Date	Power Director	No. of Grounds	Ground Locations
38	39	40	41	42	43

Figure FAR 4-12. Clearance Transfer Section of Clearance Form NEC.84

Refer to "clearance transfer section" of NEC.84 form, which consists of spaces 36-43 in Figure FAR 4-12 above.

36. **Enters** "clearance number" being transferred.
37. **Writes** "circuit/apparatus" being transferred. DO NOT use abbreviations.
    - referred to as body of clearance being transferred
38. **Enters** "Class "A" employee or Power Director Office" clearance is being transferred to.
39. **Enters** "time" clearance transferred. Includes AM or PM as part of time.
40. **Enters** "date" clearance transferred. Includes AM or PM as part of time.
41. **Signs** name after completion of clearance transfer.
42. **Records** "number of grounds applied" to circuit/apparatus as reported by Class "A" employee.
43. **Records** "locations where grounds applied" to circuit/apparatus as reported by Class "A" employee.

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APPENDIX A. GLOSSARY

AC HOLD: A term to describe the restriction on the movement of AC electric trains or engines within a specified area. Generally issued by the Amtrak Load Dispatcher or Power Director to a Train Dispatcher.

ALERNATING CURRENT: The current flows in one direction then reverses and flows in the opposite direction.

APPARENT POWER: Real power (megawatt) is used to supply energy for work, heat, and light; and reactive power (Mvar) is used to supply energy to magnetic fields. Since both types of energy are flowing on the system together, they can be combined to find the total energy flow. This total energy flow (the product of voltage and current) is called apparent power and has units of volt-amperes. Common units in operation of the power system are kVA and MVA.

ARC: A luminous and potentially destructive flash or flame in or about the wires, third rail, or electric apparatus caused by the passage of electric current through the air.

AUTHORIZED: Permission to work on or about an electrical circuit, apparatus, or equipment or given permission to enter substations, frequency converter stations, or electrical enclosures.

AUTHORIZED WORK AREA: The area established by the Class “A” employee where work may be performed.

AUTO DROP: A feature that will automatically lower the pantograph when the air system to the pantograph has been compromised.

AUTOMATIC BLOCK SIGNALING: Automatic block signaling, or ABS, is a railroad communications system that consists of a series of signals between interlockings with number plates that divide a railway line into a series of sections, or "blocks". The system controls the movement of trains between the blocks using automatic signals.

AUTOMATIC TRAIN CONTROL: Wayside equipment detects the presence of trains or other speed-limiting factors and sends electronic commands dictating the maximum speed a following train may operate through the rails. These signals are picked up by equipment on a train and compares it to the actual speedometer reading. If the actual speed exceeds the maximum allowed speed, visual and audio displays alert the engineer to lower his speed. If the engineer fails to stop or reduce speed, a penalty full stop is imposed.

AUTORECLOSE: A feature of the electrification between New Haven and Boston. This feature will attempt to automatically close a trolley circuit breaker one time upon fault.

AUTOTRANSFORMER FEEDER: A feeder adjacent to the catenary that utilizes autotransformers to maintain the overhead catenary system voltage at selected points.

AUXILIARY WIRE: A solid wire suspended from the messenger wire to which the contact wire is attached.

BACK PILOT: A term used by Utility Operators to describe potential on a transformer.

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BALANCE WEIGHT ASSEMBLY: A system of cables, pulleys and weights at the end of a tensioning section used to maintain constant in the overhead catenary system.

BELL TEMPERATURE ALARM: An alarm received when transformer windings heat up and reach a predetermined temperature value. It is necessary that the transformer be taken offline in order to minimize damage to equipment caused by overheating.

BRAKING CHOPPER: are used in the DC voltage circuits of frequency converters to control voltage when the load feeds energy back to the intermediate circuit. This arises, for example, when a magnetized motor is being rotated by an overhauling load and so functions as a generator feeding power to the DC voltage intermediate circuit.

BREAKER AND A HALF SCHEME: Developed from a ring bus arrangement, three breakers are connected between two main buses. The middle circuit breaker is shared by both the circuits. Richmond converter station's 138 kV buses are a breaker and a half scheme.

BLACKSTART RESOURCE: A generating unit and its associated set of equipment which has the ability to be started without support from the system or is designed to remain energized without connection to the system, with the ability to energize a bus.

BROKEN PANTOGRAPH/CARBON ALARM: An alarm generated when the air system to the pantograph has been compromised.

BUS BREAKER/ BUS TIE BREAKER: A circuit breaker that is positioned to connect two individual substation bus configurations.

BUS JUMPER: A cable used to transmit high voltage power between pantographs and/or one unit of electric equipment to another.

CAPACITANCE: A circuit element which stores electrical energy in the form of a static electrical charge.

CA RELAY: A relay activation found on both step-up and step-down transformers. Indicates a possible fault with the transformer. Both the high side switch and low side breaker will open. It cannot be re-energized without performing a visual inspection and doble test.

CASCADING: The uncontrolled successive loss of system elements triggered by an incident at any location. Cascading results in widespread electric train service interruption**.**

CATENARY ISOLATION SYSTEM: A system used to de-energize and ground the catenary at terminal or service and inspection location, made up of catenary disconnect switches and catenary ground switches.

CIRCUIT: The complete path over which electric current is transmitted from and returned to its source.

CIRCUIT BREAKER/ INTERRUPTER: A device which normally operates automatically under conditions of overload, short circuit, or by remote control to energize or de-energize transmission lines, signal power lines, overhead catenary system, third rail, or primary circuits on electric equipment so equipped.

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a. **AIR:** Utilizes compressed air as arc quenching medium to exterminate the arc produced when the contacts are separated.

b. **OIL:** The arc is drawn in oil to dissipate the heat and extinguish the arc; the intense heat of the arc decomposes the oil, generating a gas whose high pressure produces a flow of fresh fluid through the arc that furnishes the necessary insulation to prevent a restrike of the arc.

c. **VACUUM:** Utilizes a vacuum to extinguish arcing when the circuit breaker is opened and to act as a dielectric to insulate the contacts after the arc is interrupted.

d. **SULFUR HEXAFLUORIDE:** An inorganic, colorless, odorless, and non-flammable gas. SF6 primary use is in the electrical industry as a gaseous dielectric medium for various voltage circuit breakers, switchgear and other electrical equipment, often replacing oil filled circuit breakers that can contain harmful PCBs.

CLASS “A” EMPLOYEE: Linemen, Substation Electricians, Third Railmen and C&S employees who are trained and qualified to provide protection services as well as work on or about the electrification system.

CLASS "A" QUALIFIED LIST: A list of employees qualified in a defined territory to receive clearances. The Assistant Division Engineer - Electric Traction maintains the current list of Class "A" employees.

CLEARANCE: A document that outlines the procedure followed by the Electric Traction Department when it is necessary to remove power from circuits or apparatus in electrified territory.

CLEARANCE ISSUE: A step in the clearance procedure when the Power Director transfers authority of designated circuits or apparatus to the Class “A” employee in charge of providing protection.

CLEARANCE NUMBER: A specific, identifying number assigned to a clearance.

CLEARANCE RELEASE: A step in the clearance procedure when the Class “A” employee in charge releases authority of designated circuits or apparatus to the Power Director.

CLEARANCE REQUEST: The process initiated by the Class “A” employee to the Power Director describing relevant information regarding the designation of circuits or apparatus to be de-energized.

CLEARANCE TRANSFER: The procedure followed when a clearance needs to be re-assigned. The Power Director speaks to both Class “A” employees and when satisfied with the exchange of information, transfers the clearance.

COLLECTOR HEAD ASSEMBLY: The part of the pantograph made up of a set of carbon strips and end horns connected to the main frame of the pantograph assembly by means of an apex.

CONTINGENCY: The unexpected failure or outage of a system component, such as a generator, transmission line, switch or other electrical equipment.

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CO NEUTRAL RELAY: A relay activation only found on Step-Up Transformers except at Sub 42 Hackensack. Both the high side switch and low side breaker will open. It can be re-energized without performing a visual inspection or doble test.

CONTACT WIRE: The wire in the overhead catenary from which the pantograph collects current.

CONTINUITY JUMPER: An electrical connection in the overhead contact system; a short conductor installed to provide electrical continuity. A jumper capable of carrying full line current.

CONTRACTOR: Non-Amtrak personnel employed to work on or near Amtrak property.

CONTROL JUMPER: A cable or mechanically connected between electric equipment to transmit control power.

COUPLING: A device that connects a motor mechanism to the operating rod that controls the movement of the switch. Allows the motor mechanism to be disconnected from the operating rod for testing and maintenance.

CURRENT: The quantity of electricity which flows through a cross-section of a conductor during a unit of time.

CYCLO CONVERTER: The Cyclo Static Frequency Converter is a direct converter. In a single step, it converts three-phase 60 Hz voltages to a single-phase 25 Hz voltage. It "cuts and pastes" the three-phase voltage to develop the single-phase 25 Hz voltage. Jericho Park uses Cyclo Converters.

DC HOLD: A term to describe the restriction on the movement of DC electric trains or engines within a specified area. Issued by the Zone 1 Power Director to a Train Dispatcher.

DC LINK CONVERTER: The DC-Link Static Frequency Converter is a solid state (no moving parts) device that changes the operating frequency between two power system networks. It consists of three major components:

- A rectifier that transforms 60 Hz alternating power to direct current power.
- A DC circuit, commonly referred to as the DC-Link.
- An inverter that transforms the DC power to 25 Hz AC power.

Richmond and Sunnyside converter stations use DC link converters.

DEAD SECTION: A de-energized section in the overhead catenary system. The limits are designated by dead section signs at locations specified in the Timetable.

DE-ENERGIZED (DANGEROUS TO LIFE): Electrical circuits or apparatus disconnected from the power sources are considered dangerous to life until tested de-energized and properly grounded.

DEMAND: The rate at which electric energy is delivered to or by a system, generally expressed in kilowatts or megawatts, at a given instant or averaged over any designated interval of time.

DISPATCH: The implementation of a command decision to move a resource or resources from one place to another.

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DIRECT CURRENT: The current flow is always in the same direction.

DISCONNECT SWITCH: A mechanical switching device, either motor or manually operated, used for isolating a circuit or apparatus from a source of electrical power.

DISTURBANCE: An unplanned event that produces an abnormal system condition.

DO NOT OPERATE TAG (NEC 105): A safety tag defining operating restrictions to an electrical apparatus.

DUAL INDICATION: (Zones 1, 2, 3) Both “open” and “closed” indicators (red and green lights lit) QEI device status color is magenta (Zone 1, 2, 3) means you don’t know true status. Status Unknown (if no indication to QEI, device status purple).

ECONOMIC DISPATCH: The allocation of demand to individual generating units on line to effect the most economical production of electricity.

ELECTRIC EQUIPMENT: Locomotives and multiple unit cars operated by power received from the overhead catenary system or third rail.

ELECTRIC POWER: The rate at which electric energy is transferred by an electric circuit.

ELECTRIC TRACTION TRAINEE: Electric Traction employees that are working towards craft specific qualifications.

ELECTRIFIED TERRITORY: The portion of the railroad equipped for electric train operation.

EMERGENCY BUS: An alternate feed source for effecting outages to dedicated low rupture breakers. Sub 25A Union has an emergency bus configuration.

EMERGENCY CONDITION: A circumstance which presents a hazard to life, infrastructure or equipment that may interfere with train movement.

EMERGENCY RATING: The rating as defined by the equipment owner that specifies the level of electrical loading or output, usually expressed in megawatts or reactive power or other appropriate units, that a system, facility, or element can support, produce, or withstand fir a finite period. The rating assumes acceptable loss of equipment life or other physical or safety limitations for the equipment involved.

END APPROACH: The gradual slope or incline of the rail at the beginning and end of each third rail section. This allows for the smooth transition of the third rail shoe.

ENERGIZED- LIVE (DANGEROUS TO LIFE): Electrical circuits or apparatus, connected to a power source.

ENERGY ISOLATION DEVICE: A physical device that physically prevents the transmission or release of energy. Energy isolating devices establish the zone of protection boundaries in accordance with clearance procedures.

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EQUALIZING JUMPER: (PORTABLE EQUALIZING JUMPER): A jumper connected from the messenger wire to the contact wire installed approximately 500' in constant tension overhead catenary system that carries current from the messenger to the contact wire.

EQUIPMENT RATING: The maximum and minimum voltage, current, frequency, real and reactive power flows on individual equipment under steady state, short-circuit and transient conditions, as permitted or assigned by the equipment owner.

FAULT: A physical condition that causes electrical equipment to fail to perform as designed.

FLASHOVER: An electric discharge through air around or over the surface of insulation, between objects of different potential, caused by placing a voltage across the air space that results in the ionization of the air space.

FORCED OUTAGE: A hardware failure in the generation, transmission, distribution or signal power system that results in the equipment being removed from service for emergency reasons. Forced outages typically occur due to unexpected component failure. Regularly scheduled shutdowns of equipment for routine maintenance do not qualify as a forced outage.

FORM D: A form containing written authorizations, restrictions, or instructions, issued by the Train Dispatcher to specified individuals.

FOUL TIME: Time that the track is to be obstructed (fouled).

FRAME SHIFT: A mechanism that allows the stator of the motor to rotate a defined number of degrees. This controls the phase angle between the voltage driving the motor and voltage produced by the generator.

FREQUENCY: The number of complete voltage or current cycles per second. Frequency is expressed as Hertz.

FREQUENCY CONVERTER: A set of equipment used to supply electrical power from one electrical system to another electrical system of a different frequency.

FREQUENCY CONVERTER STATION: A location where power is received from a local utility at 60 Hz and is converted to 25 Hz for distribution to Amtrak's transmission system.

GROUND CONNECTION: An approved electrical connection made to the rail return circuit or other earth potential that is used to protect personnel, equipment and property when work is performed in electrified territory.

GROUNDING SWITCH: A device that is closed to connect wires or electric apparatus mechanically to ground.

HIGH EQUIPMENT: Equipment that, when on top of, will place employee closer than 3 feet of the overhead catenary system.

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HIGH SIDE SWITCH: A motor operated disconnect switch used to isolate or connect the primary side of a transformer.

HOME SIGNAL: Signals that govern the entrance of an interlocking.

HOOK TYPE DISCONNECT SWITCH: A mechanical switching device used to isolate a circuit or apparatus from a source of power. This type of disconnect is operated by placing the hook end of a switch pole into a ring provided on the movable blade of the switch.

HYDRO ELECTRIC GENERATING UNIT: A water source, usually a river or a series of streams, supplies water to a reservoir. Safe Harbor is the only generating station that supplies hydro power (direct 25 Hz) generation to Amtrak.

HUCK: The process of connecting third rail sticks at its joints, end approaches and/or attaching high voltage cable to third rail, using a hydraulic gun. Bolts, washers, collars and splice bars are used to secure these joints upon pressure of the hydraulic gun.

IMPEDANCE: The measure of a circuit's total opposition to current flow.

IMPEDANCE BOND: A device which separates signal track circuits from traction return circuits by providing a path for traction return current around insulated block joints.

INSULATOR: A material, such as polymer or porcelain, of such low conductivity that the flow of current through it is negligible.

LATERAL/ SECONDARY FEED : An alternate power supply to temporarily energize a signal location or cut section secondary circuits from another signal location or cut section.

LIMITS OF A CLEARANCE: The points established by the switching procedures to de-energize an area defined by the body of the clearance.

LIVE LINE TOOLS: Insulated hand-held sticks for use on high voltage circuits.

LOAD: An end-use device that receives power from the electric system.

LOAD DISPATCHER: The employee who monitors and regulates power demands for the 25 Hz electrification system.

LOCKOUT RELAY: When used in conjunction with signal equipment this relay has two positions.

a. When in the locked out position; removes the automatic and remote closing of the signal breaker.

b. When in the reset position allows the signal breaker to close automatically when an under voltage condition is detected. Also allows remote closing of the signal breaker.

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LOW D.O.: A term used by Safe Harbor to indicate low "dissolved oxygen levels" in the water. This has as effect on the Susquehanna River. Typically if this condition occurs, Safe Harbor will remove the Hydro units from service and provide generation with the frequency converter only.

LOW RUPTURE BREAKER: Usually found in switching stations, a low rupture breaker supplies the feed to a section of trolley. Controlled by the master breaker to trip for a fault on its trolley section.

LOW SIDE BREAKER: Protects the secondary side of the transformer from fault currents and overloads by opening when conditions reach a pre-determined value.

MAIN CIRCUIT BREAKER: A device located on electric equipment that interrupts the flow of power from the pantograph to the main power transformer.

MANUALLY OPERATED SWITCH: A switch operated by hand without using any other source of power.

MASTER BREAKER: Usually found in switching stations, a master breaker feeds a low rupture bus that contains several low rupture breakers. Relay protection trips the master breaker then the faulted low rupture breakers, then re-closes the master breaker when clear.

MESSENGER WIRE: A stranded cable attached to supporting structures from which the contact and/or auxiliary wires are suspended.

MINIMUM APPROACH DISTANCE: The closest distance personnel or equipment is permitted to approach an energized or de-energized but not grounded circuit or apparatus.

MIS-OPERATION: The failure of a protection system to operate as intended for protection purposes. Any of the following is a mis-operation:

a. **FAILURE TO TRIP DURING FAULT:** A failure of a protection system to operate for a fault condition for which it is designed.

b. **FAILURE TO TRIP OTHER THAN FAULT:** A failure of a protection system to operate for a non-fault condition for which it is designed, such as a power swing, undervoltage, overexcitation, or loss of excitation.

c. **SLOW TRIP DURING FAULT:** A protection system that is slower than required for a fault condition if the duration of its operating time resulted in the operation of at least one other element's protection system.

d. **SLOW TRIP OTHAN THAN FAULT:** A protection system that is slower than required for a non-fault condition, such as a power swing, undervoltage, overexcitation, or loss of excitation, if the duration of its operating time resulted in the operation of at least one other element's protection system.

e. **UNNECESSARY TRIP DURING FAULT:** An unnecessary protection system operation for a fault condition on another element.

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f. **UNNECESSARY TRIP OTHER THAN FAULT:** An unnecessary protection system operation for a non-fault condition.

MOTOR OPERATED AIR BREAK SWITCH: A switch whose insulator stack upon which the disconnect switch is mounted is connected to a motor mechanism at the base of the switch. The switch is normally operated remotely. Used to sectionalize, tie, or isolate transmission line circuits.

MOTOR OPERATED SWITCH: A disconnect switch that is connected to a motor operated mechanism at the base of the switch. To open or close this disconnect switch the motor operator mechanism receives a power signal and turns the connecting rod, in the process simultaneously moving the switch blades out of the fixed jaw or fitting the switch blade into the fixed jaw.

MULTIPLE UNITS: Electric equipment used by commuter railroads in local passenger service. Most units have a pantograph on each car. There are some units called married pairs that have one pantograph for two units.

NEGATIVE FEEDER- 25 KV (NEW ENGLAND DIVISION): A feeder adjacent to the catenary that utilizes autotransformers to maintain the catenary voltage at selected points.

NORMAL CLEARING: A protection system operates as designed and the fault is cleared in the time normally expected with proper functioning of the installed protection systems.

NORMAL RATING: The rating as defined by the equipment owner that specifies the level of electrical loading, usually expressed in megawatts or other appropriate units that a system, facility, or other element can support or withstand through the daily demand cycles without loss of equipment life.

OFF-PEAK: Those hours or other periods defined by Amtrak business practices or guides as periods of lower electrical demand.

ON-PEAK: Those hours or other periods defined by Amtrak business practices or guides as periods of higher electrical demand.

OPERATING GUIDELINE: A document that identifies specific steps or tasks that should be taken by one or more specific operating positions within Amtrak to achieve specific operating goals. The steps presented in an Operating Guideline should be followed in the order they are presented, and should be performed by the positions identified. A document that lists the specific steps for a system operator to take in removing a specific transmission line from service is an example of an Operating Guideline.

OPERATING RESERVE: That capacity above firm system demand required to provide for regulation, load forecasting error, equipment forced and planned outages.

OPERATING VOLTAGE: The voltage level by which an electrical system is designated and to which certain characteristics of the system are related.

OPERATIONAL PLANNING ANALYSIS: An analysis of the expected system conditions for the next-day's operations. Expected system conditions include things such as load forecasts, generation output levels, and known system constraints (converter outages, equipment limitations etc.).

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OPERATIONS SUPPORT PERSONNEL: Individuals who perform current day or next day outage coordination or assessments. Direct support of real-time operations for Amtrak's Electric Traction Department.

OVERHEAD CATENARY SYSTEM: A system of wires suspended between poles and bridges supporting overhead wires.

a. **FIXED TENSION:** A fixed system of wires suspended between poles and bridges supporting overhead wires.

b. **CONSTANT TENSION:** A system of wires provided with balance weight tensioning devices to maintain constant tension.

PANTOGRAPH: A device located on top of electric equipment which collects electric power from the contact wire by means of a collector head assembly.

PARALLELING STATION: A substation located at controlled points along the territory where the catenary and feeder are connected through autotransformers to balance and maintain the overhead catenary voltage.

PEAK DEMAND: The highest hourly integrated net energy for load within an area occurring within a given period.

PERMIT: Issued by the Load Dispatcher granting permission to disconnect and isolate primary circuits and apparatus under the Load Dispatcher's direction.

PERSON IN CHARGE: The individuals being Amtrak employees or contractors whose designated responsibility is to supervise the work group afforded protection by the Class "A" employee. The Class "A" employee may also be the "Person in Charge".

PHASE BREAK: A location in the overhead catenary system where overhead wires are arranged to provide an isolated section between different sources of power.

PHASE IN: A term used by the Load Dispatcher to reconnect portions of the electrified system after an outage or split phase condition.

PLANNED OUTAGE: Interruptions to the system prearranged on relatively short notice.

PLATE NUMBER: Obtained from the Plate Book, the Plate Number is the specific number assigned to a given plate. This number is used on the Plate Order to designate the track and define the limits covered by the Power Plate.

PLATE ORDER: A document which acknowledges that a section of the overhead catenary system or third rail may be de-energized. It graphically communicates this fact to all involved parties that electric trains or electric equipment are prevented from moving into the de-energized area.

POINT OF DELIVERY: A location that the transmission service provider specifies on its transmission system where an interchange transaction leaves or a load-serving entity receives its energy.

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POLE PIECES: Determines the frequency in a motor-generator.

- There are 10 pole pieces on a 25 Hertz generator rotor.
- There are 24 pole pieces on a 60 Hertz motor rotor.
- 10 x 60 = 25 Hertz
  24.

POTENTIAL TRANSFORMER: A transformer connected to a substation bus section used to provide voltage input to the 110V relay potential bus, and back pilot indication at step-up stations. (Relay Protection Scheme)

POTENTIAL TRANSFORMER SELECTOR SWITCH: A three position selector switch (i.e.: 20 Bus, off, 19 Bus) found on the relay and control board in most substations that allows for the transfer of relay potential to a selected bus section. The normal configuration is such that the selector switch is pointing to the bus it is being fed from (i.e.: P19 on #19 Bus).

POWER DIRECTOR: The employee who is in charge of the electrification system within their assigned territory.

POWER DIRECTOR OPERATING ZONE: A geographical section of the Amtrak electrified system whose switching and monitoring operations are conducted under the direction of the Amtrak Power Director.

POWER FACTOR: The fraction or percent of the total energy flow that is being used for useful energy such as work, heat, or light.

POWER SECTIONALIZING PLATE: A diagram which indicates the area in which there are to be no electric train or electric equipment movement.

PROGRAMMABLE LOGIC CONTROLLER: is an industrial computer control system that continuously monitors the state of input devices and makes decisions based upon a custom program to control the state of output devices. PLCs can be found at Jericho Park, Richmond and Sunnyside converter stations.

QUAILIFIED PERSON: An individual officially recognized as being trained and has successfully demonstrated ability to perform a particular job.

PROTECTION SYSTEM: Control circuitry associated with protective functions through the trip coil of circuit breakers or other interrupting devices. Protective relays which respond to electrical quantities.

RACK-OUT CIRCUIT BREAKER: A circuit breaker that may be completely removed from its enclosure for maintenance.

RAIL RETURN: The combination of rails, jumpers, impedance bonds and cables that provide an electrical return path from the train to the substation.

RATING: The operational limits of a transmission system element under a set of specified conditions.

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REACTIVE POWER: It is the product of the voltage and the out-of-phase component of the current. Sometimes called volt-amperes-reactive (var), is associated with the reactance of the circuit. Reactive power regulates the voltage in the system.

REAL POWER: The portion of electricity that supplies energy to a load. Real power (megawatt) is the flow rate of a particular type of energy, called useful or working energy.

RELIABLE OPERATION: Operating the elements of the system within equipment and electric system thermal, voltage, and stability limits so that instability, uncontrolled separation, or cascading failures of such system will not occur as a result of a sudden disturbance or unanticipated failure of system elements.

REMOTE CONTROL BOARD: A switch panel used for the operation and supervision of Electric Traction equipment/apparatus.

REMOTE TERMINAL UNIT: Hardware that gathers system-wide real-time data from various locations for telemetry and remote control of field equipment to a centralized control center.

RESISTANCE: The opposition to electrical current flow. Measured in “ohms”.

RING BUS CONFIGURATION: All breakers are arranged in a ring with circuits tapped between breakers. For a failure on a circuit, the two adjacent breakers will trip without affecting the rest of the system. A single bus failure will only affect the adjacent breakers and allow the rest of the system to remain energized. A breaker failure or breakers that fail to trip will require adjacent breakers to be tripped to isolate the fault. Lamokin Step-Up Yard is a ring bus configuration as well as Sub 40 Waverly.

138 kV BUS SECTION (ROOF BUS): That portion of the (138 kV) transmission system located in the substation between the air break switches, tie switches, and high side switches to which the power transformers connect.

ROTARY FREQUENCY CONVERTER: Rotating Frequency Converters are large motor generator sets consisting of a 60 Hz, three-phase motor with a 13.8 kV input that drives a 25 Hz, single-phase generator with an output of 13.2 kV. The mechanical energy of the motor drives a shaft coupled with the generator to produce the electrical energy required for distribution to the step-up yard. Lamokin, Safe Harbor and Metuchen converter stations use rotary frequency converters.

SCHEDULED OUTAGE: Routine interruptions planned well in advance such as those scheduled for routine maintenance or inspection of equipment.

SECONDARY FUSE: A fuse installed to protect the secondary side of a transformer. Should be removed to provide isolation for clearances.

SECTION BREAK: A location designed to provide a separation of circuits while allowing for a continuous collection of power from the overhead catenary system.

SECTIONALIZING SWITCH: Apparatus which is used to isolate or connect sections of the catenary, signal power or third rail.

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SERVICE TRANSFORMER: A transformer connected to a substation bus used to provide station service power, such as lighting and control.

SERVICE TRANSFORMER SELECTOR SWITCH: A two position selector switch (i.e.: S20, S19) found on the relay and control board in most substations that allows for the transfer of station service power from a selected bus section. Traditionally configured so that the service is fed off the bus section represented by the substation location (i.e.: Sub 20 on S20).

SHIFT TURNOVER: A transfer of responsibility and information regarding the status of the system from the outgoing to incoming Load Dispatcher or Power Director.

SIGNAL BREAKER: A component of the signal power system with automatic and lock out features, strategically located to feed or tie into the signal power line.

SIGNAL CUT SECTION: A C&S Instrument house (CIH) between interlockings with no wayside signals. Serves as a repeater for signal circuits between wayside signal locations.

SIGNAL FLIP: A term used when the current feed to the signal line must be changed. This is a planned disruption to the signal feed arrangement between the Power Director and those having jurisdiction over the affected area.

SIGNAL INTERRUPTION: A term used when an unscheduled interruption to the signal line occurs due to faults and power losses causing a signal machine or signal breaker to trip. This would be a momentary loss of signals as signal feeds from other sources would be closed automatically or manually to re-energize the signal line.

SIGNAL LOCATION: A location that has wayside signals. This can be a home signal or automatic block signal location.

SIGNAL MACHINE: A motor-generator or static unit strategically located, generates power to supply the feed for the signal power system.

SIGNAL OUTAGE: A term used when signal line power is interrupted for a sustained period of time.

SILICON CONTROLLED RECTIFIER: A power electronic component that cuts and pastes the three-phase voltage to develop the single-phase 25 Hz voltage. Can be found at Amtrak's Jericho Park converter station.

SINGLE-PHASE TWO WIRE CIRCUIT: A single phase AC circuit supplied through two wires. As an example, the 25 Hz catenary is a single-phase two wire circuit. One wire is the trolley and the second wire is the rails.

SINGLE-PHASE THREE WIRE CIRCUIT: A single phase AC circuit consisting of three wires, one of which is identified as the neutral conductor. As an example, Northeast Division East (formerly the New England Division) 60 Hertz catenary system has three conductors. One conductor is the trolley wire, one conductor is the feeder wire, and the rails act as the neutral conductor.

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SITUATIONAL AWARENESS: The ability to identify, process, and comprehend the critical elements of information pertaining to your job. More simply, it's knowing what is going on around you.

SOLID HOLD: A term to describe the restriction on the movement of all equipment within a specified area. Generally issued by the Power Director to a Train Dispatcher.

SPILLING: A term used by Safe Harbor to indicate too much water in the bay. Amtrak will generally take extra megawatts when this condition occurs.

SPINNING RESERVE: Unloaded generation that is synchronized and ready to serve additional demand.

SPLIT PHASE: A condition where one or more sources of generation are separated to create an island affect.

STABILITY: The ability of an electric system to maintain a state of equilibrium during normal and abnormal conditions or disturbances.

STATIC FREQUENCY CONVERTER: Uses power electronics technology to convert three-phase input voltages directly to a single-phase voltage operating at a different frequency. Jericho Park, Richmond Metuchen and Sunnyside converter stations use static frequency converters.

STATIC WIRE: The wire normally located on top of pole which protects conductors from lightning by providing a low resistance path to ground. Without a static wire, lightning induced voltage would otherwise build up on power line conductors during a lightning strike and cause damage.

STATUS UNKNOWN: (Zones 4, 5, 6 and 8 only): On SCADA, device status goes to a flashing blue indication. This means it is unknown if the device is open or closed. There are two variations of status unknown.

a. **TRANSIT:** Indicates that neither indication points is being seen (open or closed). Removing DC control from the device is an example of a transit status.

b. **MALFUNCTION:** Indicates that both indication points are being seen simultaneously (open and closed).

SUBSTATION: A location where power is received at high voltage and changed to required voltages and characteristics for distribution to the overhead catenary system, third rail, and other electric apparatus.

SUPERVISORY CONTROL AND DATA ACQUISITION: A system of remote control and telemetry used to monitor and control the operation of devices and the collection of device status.

SUSTAINED OUTAGE: The de-energized condition of a transmission line resulting from a fault or disturbance following an unsuccessful reclosing procedure.

SWITCHING: The operation of any electrical switchgear.

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SWITCHING STATION: An arrangement of feeders, breakers and switchgear designed to maintain continuity or isolate between substations and strategically located in high volume traffic areas where it may not be practical or necessary to have power transformers.

SWITCHING STATION (NEW ENGLAND DIVISION): A location midway between substations, which provides the function of paralleling stations and switching capabilities to bypass dead sections with adjacent substation power.

SYNCHRONISM: The condition when connected AC systems, machines, or a combination of the two operate at the same frequency and when the angle displacement between voltages in them are constant, or vary about a steady or stable position.

SYSTEM: A combination of generation, transmission, and distribution components.

TAG: Whether a paper-based hard copy or a computer-based electronic copy, a tag is attached to circuit apparatus or electrical equipment to designate its unavailability for operation. Provides personnel as well as system safety.

TELEMETERING: The process by which measurable electrical quantities from substations and converter stations are instantaneously transmitted to the control center, and by which operating commands from the control center are transmitted to the substations and converter stations.

TEMPORARY CLEARANCE RELEASE: A temporary release of an issued clearance that officially allows the limits of the clearance to be energized for a short period of time to facilitate activities such as testing or routing of trains.

TENSION LENGTH: One wire length between terminations, from balance weight to balance weight with midpoint anchor or from balance weight to fixed termination in the overhead catenary system.

THERMAL RATING: The maximum amount of electrical current that a transmission line or electrical facility can conduct over a specified time period before it sustains permanent damage by overheating.

THIRD RAIL: An electrified rail located alongside and above the inner/near running rail from which a sliding contact shoe attached to the truck of electric equipment collects direct current.

THIRD RAIL GAP: A break or separation in the third rail, which begins and ends with an end approach.

THIRD RAIL POWER PERMIT: A written document that outlines the procedure followed by the Electric Traction Department when it is necessary to remove power from DC circuits or apparatus in third rail electrified territory.

THIRD RAIL POWER PERMIT NUMBER: A specific, identifying number assigned to a third rail power permit.

THIRD RAIL SHOE (CONTACT SHOE): A device located on the side of electric equipment that collects electric power from the third rail by means of a sliding contact.

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THIRD RAIL WARNING DEVICE: A device attached between the third rail and inner/near running rail, which indicates an energized or de-energized circuits or apparatus.

TIE SWITCH: A mechanical switching device, either motor or manually operated, that is closed to connect two buses or segments of the catenary system, the third rail system, the transmission system, or signal power lines together.

TRACK HEATER STATION: Located at various locations along the right of way. Track Heater Stations are used to melt snow and ice from rail switches to allow smooth switch operation during inclement weather conditions.

TRACK OCCUPANCY LIGHT: Used to track train movement. During a signal power failure, C&S track circuits will fail showing TOL's in the affected area. A Train Dispatcher's ability to display signals and visually monitor train movement over those sections are absent. The CTC display will indicate in red those sections of the railroad effected.

TRAIN DISPATCHER: The employee responsible for the movement of trains within an assigned territory.

TRANSFORMER: Apparatus, which serves to increase or decrease AC voltage.

TRANSMISSION LINE: A system of structures, wires or cables, insulators and associated hardware that carry electric energy from one point to another in an electric power system. Lines are operated at relatively high voltages and are capable of transmitting large quantities of electricity over long distances.

TRANSMISSION SYSTEM: An interconnected group of lines and associated equipment for the movement or transfer of electric energy between points of supply and points at which it is transformed for distribution or delivered to other electric systems.

TRANSFER SWITCH: (i.e.: "S1") When opened (OOS), transfers relay protection for the associated low rupture bus from the master breaker being taken out of service, to another master breaker. This will also disable the auto-close feature of the master breaker being taken out of service.

TROLLEY BREAKER: A component of the traction power distribution system used to supply electrical power to the overhead catenary system for the propulsion of electric trains.

UNPLANNED OUTAGE: Any interruption in the generation, transmission, distribution or signal power system which is not scheduled.

VEGETATION: All plant, material, growing or not, living or dead.

VOLTAGE: Electrical potential or potential difference expressed in volts.

VOLTAGE SENSING DEVICE: A device used by qualified employees to test whether circuits are energized or de-energized.

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WATT: A very small unit of power.

a. **MEGAWATT:** One million watts.

WAYSIDE POWER CUBICLE (NEW ENGLAND DIVISION): Located along the right away adjacent to an interlocking. They contain equipment such as a RTU, battery changer and 132 DC battery bank. These components are essential in the operation of sectionalizing switches that are located within the interlocking. They are also used for interlocking lighting thru a transfer switch. The transfer switch gives you the capability to feed off track #1 or #2.

WAYSIDE SIGNAL: A wayside signal is basically any signal - electrical, mechanical or otherwise - in a fixed location along or above the track to convey information to the train engineer.

WORK PERMIT: A documented record between the Power Director and Class "A" employee when required to repair or test devices when an electrical clearance is not required. No temporary protective grounds are applied and may include operating restrictions or instructions.

WORK PERMIT NUMBER: A specific, identifying number assigned to a work permit.

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APPENDIX B. ABBREVIATIONS AND ACRONYMS

The Power Director may be required to record information during their shift. Documents may include but not limited to; Log Book, Clearances, Out of Service Equipment, Shift Turnover and Emails etc. The use of approved abbreviations or acronyms may be necessary due to time limitations or space restrictions on forms to enter the necessary information.

An abbreviation is a shortened or contracted form of a word or phrase, used to represent the whole. Some examples of abbreviations would be PD for Power Director, Hz for Hertz and Adv for Advised.

An acronym is a form of an abbreviation. It is a word formed from the initial parts of a name and can be letters or syllables. Some examples of acronyms would be SCADA for Supervisory Control and Data Acquisition and MBTA for Massachusetts Bay Transportation Authority.

This guideline presents typical abbreviations & acronyms that may be used to make the logging process easier.

ABS	AIR BREAK SWITCH	**HZ**	HERTZ
AC	ALTERNATING CURRENT	**INT**	INTERLOCKING
ACB	AIR CIRCUIT BREAKER	**IOL**	INSULATED OVERLAP
ADE	ASSISTANT DIVISION ENGINEER	**I/S**	IN SERVICE
ADV	ADVISED	**JCT**	JUNCTION
ASUSD	AUTOMATIC START UP SHUT DOWN	**JP**	JERICHO PARK
ATDA	AMERICAN TRAIN DISPATCHER ASSOCIATON	**KV**	KILOVOLT
BB	BUS BREAKER	**KVA**	KILOVOLT- AMPERE
B&B DEPT	BRIDGES & BUILDINGS DEPARTMENT	**LA**	LIGHTNING ARRESTOR
BG&E	BALTIMORE GAS & ELECTRIC	**LAM**	LAMOKIN
BPA	BROKEN PANTOGRAPH ALARM	**LD**	LOAD DISPATCHER
BT	BUS TIE (BREAKER)	**LIRR**	LONG ISLAND RAILROAD
BTA	BELL TEMPERATURE ALARM	**MAD-N**	MID-ATLANTIC DIVISION NORTH
C&S DEPT	COMMUNICATIONS & SIGNALS DEPARTMENT	**MAD-S**	MID-ATLANTIC DIVISION SOUTH
C&T	CLOSE & TRIP	**MARC**	MARYLAND AREA RAIL COMMUTER
CETC	CENTRAL ELECTRIFICATION & TRAFFIC CONTROL	**MBTA**	MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
CIH	CENTRALIZED INSTRUMENT HOUSE	**MCB**	MAIN CIRCUIT BREAKER
CK	CHECK	**MET**	METUCHEN
CNOC	CONSOLIDATED NATIONAL OPERATIONS CENTER	**MOAB**	MOTOR OPERATED AIR BREAK
COMM	COMMUNICATION	**MOD**	MOTOR OPERATED DISCONNECT
CON-ED	CONSOLIDATED EDSION	**MP**	MILE POST
CP	CAT POLE/ CONTROL POINT	**MTO**	MANAGER TRAIN OPERATIONS

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CS	CUT SECTION
CT	CURRENT TRANSFORMER
CTC	CENTRALIZED TRAFFIC CONTROL
DC	DIRECT CURRENT
DEPT	DEPARTMENT
DPO	DROP PANTOGRAPH ORDER
DS	DISCONNECT SWITCH/ DEAD SECTION
EBHS	EAST BOUND HOME SIGNAL
ET	ELECTRIC TRACTION
E-TECH	ELECTRONIC TECHINCIAN
FTO	FAIL TO OPERATE
GF	GANG FOREMAN
GIS	GAS INSULATED SWITCHGEAR
NYPD	NEW YORK POWER DIRECTOR
OC	OVERCURRENT
OCB	OIL CIRCUIT BREAKER
OCS	OVERHEAD CATENARY SYSTEM
OOS	OUT OF SERVICE
PB	PHASE BREAK
PCY	PENN COACH YARD
PD	POWER DIRECTOR
PECO	PHILADELPHIA ELECTRIC COMPANY
PLC	PROGRAMMABLE LOGIC CONTROLLER
PPL	PENNSYLVANIA POWER & LIGHTING
PT	POTENTIAL TRANSFORMER
RFC	ROTARY FREQUENCY CONVERTER
RIO	REVERSE INSULATED OVERLAP
RSFC	RICHMOND STATIC FREQUENCY CONVERTER
RR	RAILROAD
RTS	RETURN TO SERVICE
RTU	REMOTE TERMINAL UNIT
SBHS	SOUTH BOUND HOME SIGNAL
SCADA	SUPERVISORY CONTROL & DATA ACQUISITION
SCR	SILICON CONTROLLED RECTIFIER
SECT	SECTION
SEPTA	SOUTHEASTERN PENNSYLVANIA TRANSPORTATION AUTHORTY
MU	MULTIPLE UNITS
MVA	MEGA VOLT AMP
MW	MEGAWATT
NBHS	NORTH BOUND HOME SIGNAL
NCF	NO CAUSE FOUND
NED-E	NEW ENGLAND DIVISION EAST
NED-W	NEW ENGLAND DIVISION WEST
NFW	NOTHING FOUND WRONG
NGR	NEUTRAL GROUND RESISTOR
NJT	NEW JERSEY TRANSIT
NPO	NO POWER OUTAGE
NTIC	NO TRAIN IN CIRCUIT
NYD	NEW YORK DIVISION
SFC	STATIC FREQUENCY CONVERTER
SF6	SULFAR HEXAFLUORIDE
SH	SAFE HARBOR
SHSY	SOUTH HAMPTON STREET YARD
SIG LOC	SIGNAL LOCATION
SL	SIGNAL LOCATION_NEW YORK DIV.
SOI	STANDARD OPERATING INSTRUCTION
SR ENG	SENIOR ENGINEER
SSYD	SUNNYSIDE YARD
SUB	SUBSTATION
SUPV	SUPERVISOR
SUY	STEP-UP YARD
TD	TRAIN DISPATCHER
TEMP	TEMPORARY
TOL	TRACK OCCUPANCY LIGHT
TSO	TRANSMISSION SYSTEM OPERATOR
XFMR	TRANSFORMER
VCB	VACUUM CIRCUIT BREAKER
WBHS	WEST BOUND HOME SIGNAL
WTC	WASHINGTON TRAIN CONTROLLER
WW	WATER WHEEL
XO	CROSSOVER